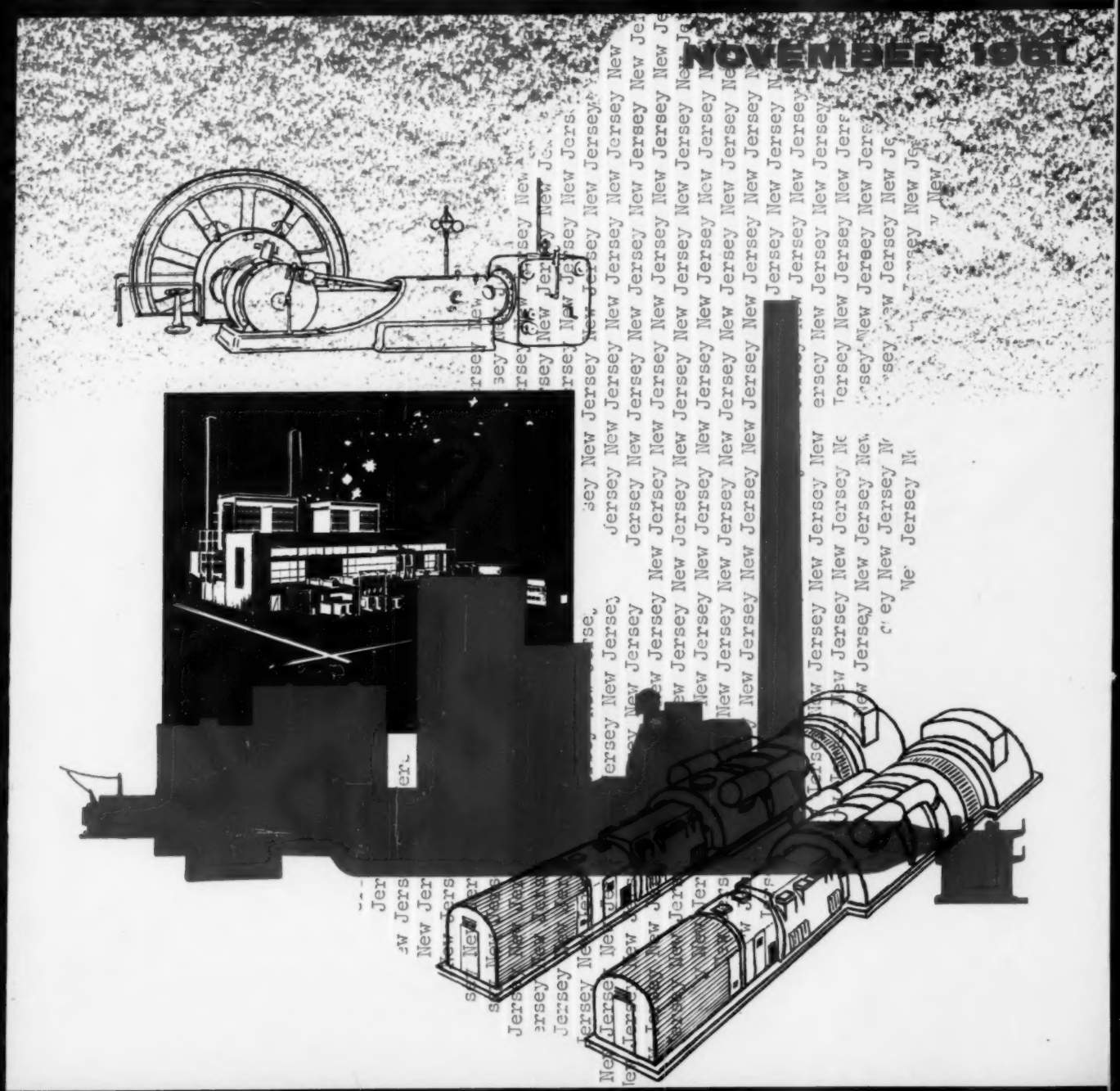
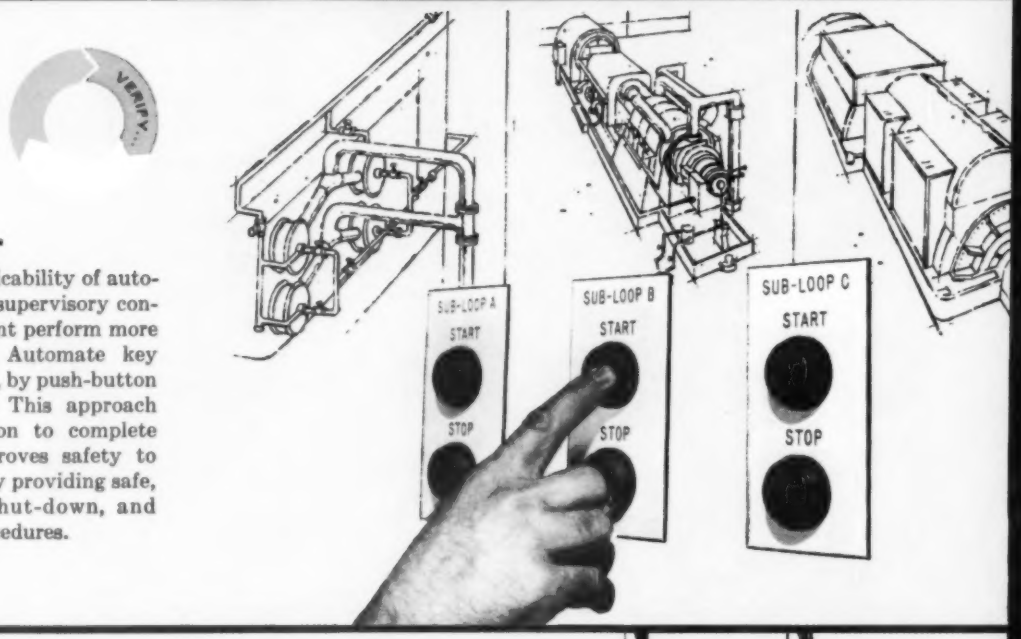
Power Engineering®



COST PER KW LOWERED IN MERCER PLANT DESIGN

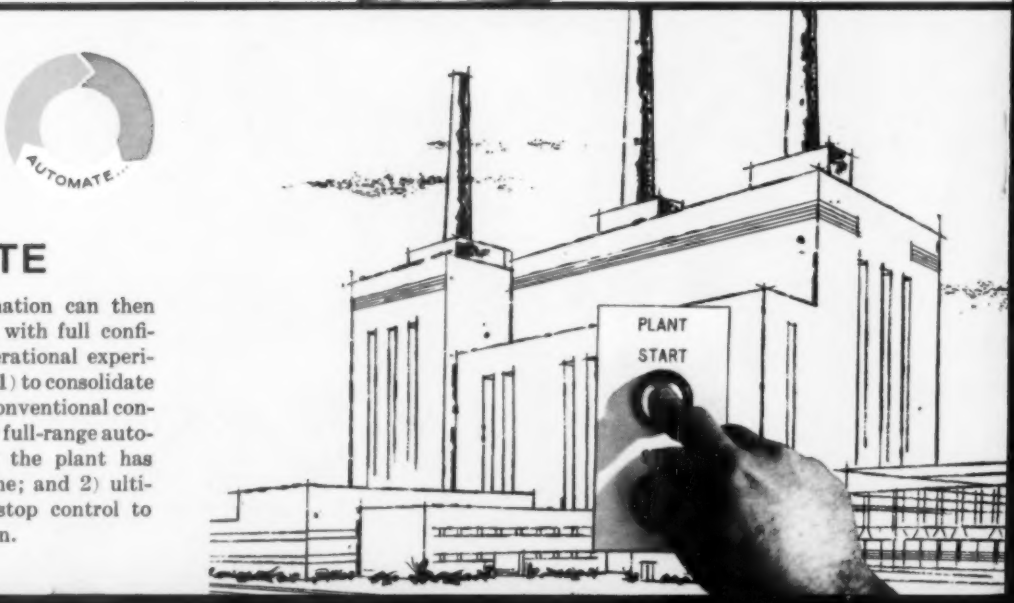
FIRST SIMPLIFY...

First step to automation is to *simplify* the information now presented by a multitude of multi-record charts, gages, and annunciator lights. The Bailey approach gives the operator data he needs (logged periodically), keeps continuous watch on all variables, makes calculations where required, alarms when trouble threatens. Reliability of recorded data is increased . . . operators can devote full attention to correcting off-normal conditions and improving operations.



NEXT VERIFY...

Next, verify the practicability of automation by extending supervisory controls, letting equipment perform more operating functions. Automate key systems, one at a time, by push-button controlled sub-loops. This approach smooths the transition to complete automation and improves safety to men and machinery by providing safe, uniform start-up, shut-down, and normal operating procedures.



THEN AUTOMATE

Final steps to automation can then be made at any time with full confidence and proved operational experience. These steps are: 1) to consolidate supervisory controls, conventional controls, and sub-loops for full-range automatic operation once the plant has been placed on the line; and 2) ultimately, to add start-stop control to provide full automation.

How to get *assured results* from AUTOMATION

...and gain as you go

Complete automation is a long step forward — with many challenges along the way.

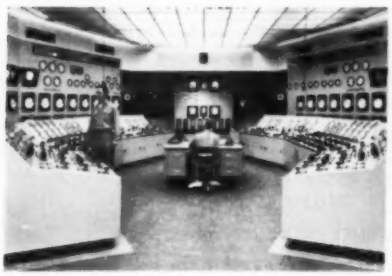
The Bailey step-by-step approach to automation makes possible step-by-step certainty ... provides step-by-step benefits ... requires only step-by-step commitment.

In the initial steps it makes possible many or most of the benefits of complete automation with considerably less investment than required for the ultimate. And it permits the decision to take each succeeding step to be made only after satisfactory evidence that it is economically justified and functionally sound.

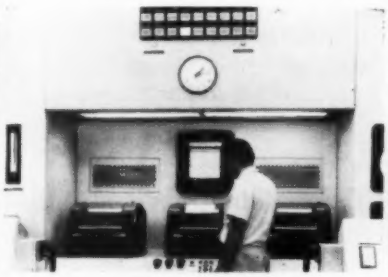
Bailey 700 Systems draw on the best available techniques, including analog and digital manipulation, trend recording, time sharing, scanning, alarming, calculating, controlling, and logging, as required to meet operating objectives. Individual systems, including logic and sequence units, are coordinated by Bailey's distinctive method of *parallel programming* to achieve plant automation. The parallel-programming approach improves plant availability by making it practical to remove individual systems from service or reprogram without disturbing operation.

Ask your Bailey District Office, or write for more information on the Bailey step-by-step approach to automation with Bailey 700 Systems. Bailey Meter Company, 1040 Ivanhoe Road, Cleveland 10, Ohio. In Canada —Bailey Meter Company Limited, Montreal.

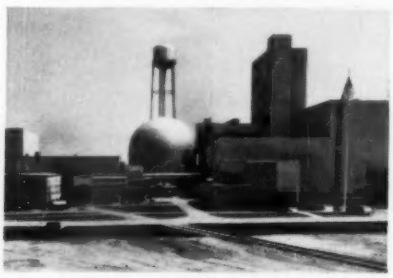
Bailey Systems Concepts are Founded on 45 years of Experience



Twenty-one of the twenty-six most efficient steam-electric stations in the United States use Bailey Instruments and Controls.* This reflects more than 45 years of Bailey developments devoted to improving the reliability of power-plant operation. **Listed in Federal Power Commission Report S-143.*



Bailey experience in automation dates from electrically operated boiler controls in 1924, automatic start of boiler controls on steam-electric locomotive in 1936, and fully automated package boilers in 1948. This Bailey 750 System for simplified display of power-plant operating information was installed in 1959.



Bailey experience extends to and includes the atomic power field. In the completion of the Enrico Fermi Atomic Power Plant at Monroe, Mich. in 1961, Bailey Meter Company was prime instrument contractor, supplying both pneumatic and transistorized electronic control systems. A165-2

BAILEY METER COMPANY

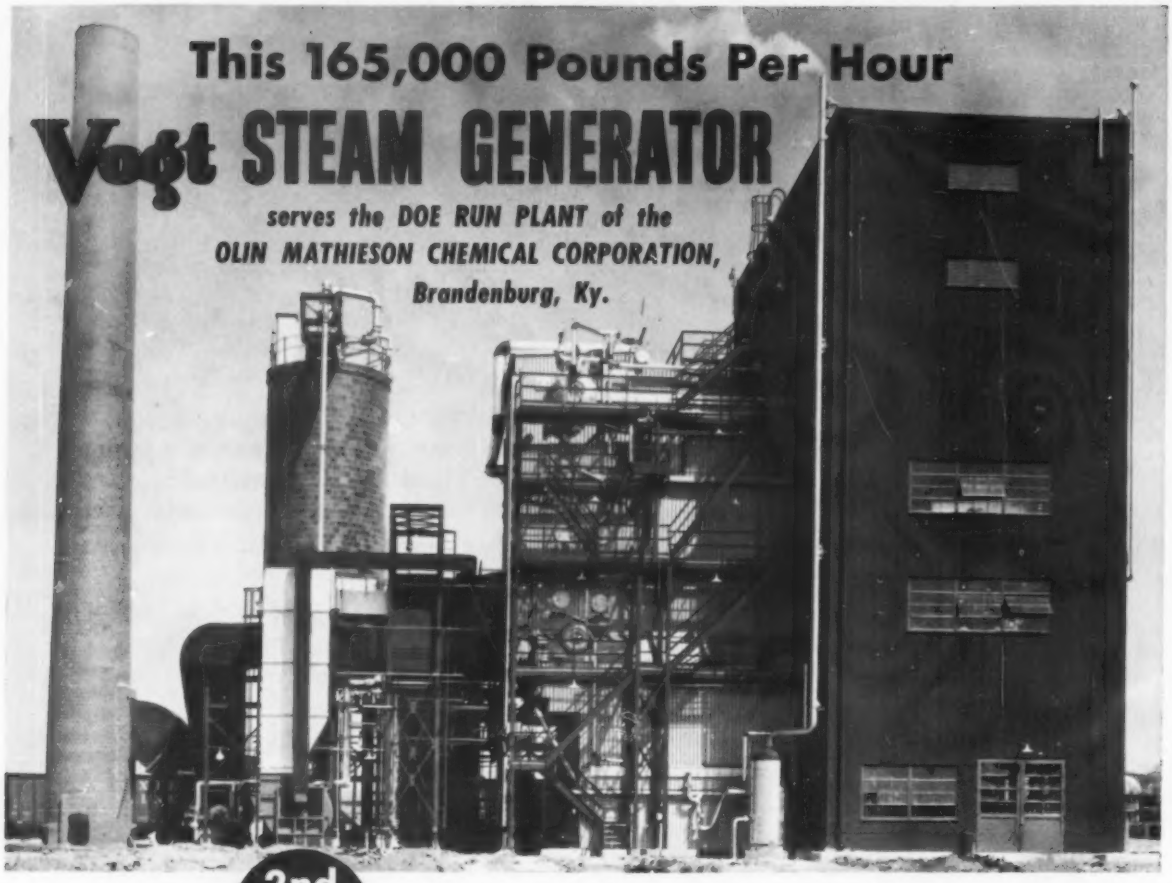
700 Systems

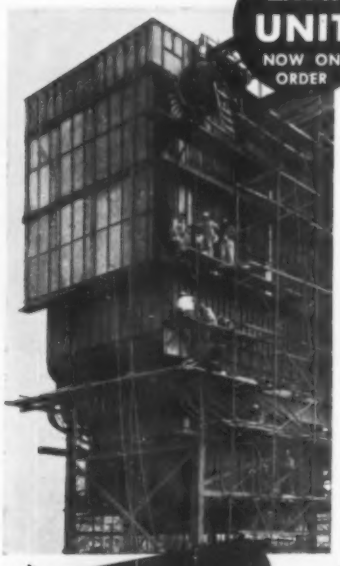
For more data circle 501 on Post Card

This 165,000 Pounds Per Hour

Vogt STEAM GENERATOR

serves the DOE RUN PLANT of the
OLIN MATHIESON CHEMICAL CORPORATION,
Brandenburg, Ky.





Installed out-in-the-open, the unit generates 165,000 pounds of steam per hour at an operating pressure of 650 psig and 750°F. total temperature when firing pulverized coal or gas in a tangent tube, fully water cooled, pressure tight, steel encased setting.

Outdoor installations, with firing equipment housed, have been promoted by Vogt for many years. They help reduce building and operating costs in leading chemical plants and refineries across the nation.
Contact the Vogt representative nearest you before purchasing new steam generating equipment.

For Custom Installation Bulletin VF-VS-2. Package Unit Bulletin PSG-3 address Dept. 24A-BPE.

J. F. Pritchard & Co.
Engineers-Constructors

For Direct Long Distance to Louisville dial: 502 ME 4-9411

Vogt STEAM GENERATORS

HENRY VOGT MACHINE CO., P. O. BOX 1918, LOUISVILLE 1, KY.

SALES OFFICES: Camden, N. J., Charleston, W. Va., Chicago, Cleveland, Dallas, Los Angeles, New Orleans, New York, San Francisco, Seattle, St. Louis

For more data circle 502 on Post Card

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Comment

The great importance of power engineering is once again displayed in the AIEE General Meeting and the ASME Winter Annual Meeting.

Programs for both sessions dramatically illustrate the wide scope of our field today, and cover all phases—from generation to utilization.

This proves our point, we feel, when we say that today's Power Engineer is interested in ALL facets of the field—not just one.

Bob McCaw

EDITOR

Power Engineering®

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Circulation This Issue..... **43,548**

Complete editorial index

ON THE COVER

We pay tribute to the new Mercer Station, recently dedicated by PSE & G Co. of New Jersey. This great utility has successfully handled its tremendous load growth by progressing from the steam engine of 1888—to the 320-Mw units of 1961. See the article beginning on page 41.

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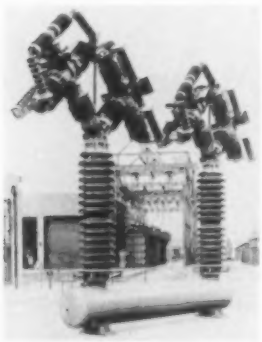
around the power circuit



Prototype of one phase of English Electric's new frame "r" air-blast circuit-breaker, with part of company's switchgear testing station at Stafford, England, in background

FIRST 35,000-MVA switchgear for a new 400-kv supergrid—believed to have the highest rating of any switchgear yet developed—will be built by English Electric for the Central Electricity Generating Board in Britain.

It will be installed at the new West Burton power plant in Nottinghamshire for which English Electric is already building the world's first 500-Mw single-shaft steam turbine-generators.

The change from 275 kv to 400 kv, plus the higher current rating of the new supergrid, will make it possible to almost treble the amount of power that can be transmitted without increasing the number of overhead lines.

Worth over $4 million, the English Electric order covers thirteen 35,000-mva air-blast, frame "r" circuit breakers, eight rated at 4000 amp and five at 2000 amp, with power-operated isolators and associated equipment.

CONSOLIDATED EDISON CO. of New York has ordered a steam turbine-generator which is expected to generate in excess of one million kilowatts of power. It will be part of a $131-million generating facility adjacent to the utility's East River Station, and will be built by Allis-Chalmers.

The huge machine will be of cross-compound design. The turbine will have five sections: one high pressure, one intermediate pressure and three low pressure. The high and intermediate pressure sections will be coupled in tandem to drive one of the two fully supercharged, hydrogen-cooled generators at 3600 rpm.

The three low-pressure turbine sections will be coupled in tandem to drive the other generator at 1800 rpm. Steam will be supplied at 2400 psi 1000 F, will return for reheat to 1000 F.

The new unit is scheduled for operation in 1966.

CAROLINA POWER & LIGHT CO. has broken ground at Skyland, N.C., for its proposed 255,000-hp steam-electric generating plant. The initial unit, one of several planned for this site, will go on the line in mid-1964. CP&L will build a 300-acre lake at the site as a source of cooling water for the plant's condensers.

Largest steam-electric generating facility in western North Carolina, the plant will be capable of generating 1,130,000,000 kwh each year and will bring CP&L's system generating capability to well over 2,500,000 hp.

CONTRACT for a 242-000-kw underground French-Belgian nuclear power plant has been awarded to Westinghouse Electric International Co. of the United States, Ateliers de Constructions Electriques de Charleroi, of Belgium, and Framatome, of France. Location is at Chooz, France, near the Belgian border in the Ardennes region.

The project for a closed-cycle water reactor of Westinghouse design was accepted by the Council of Ministers of Euratom under the program of investment in large plants for the six-nation European community (France, Belgium, Luxembourg, The Netherlands, Italy and West Germany). The program is scheduled to be completed by 1965.

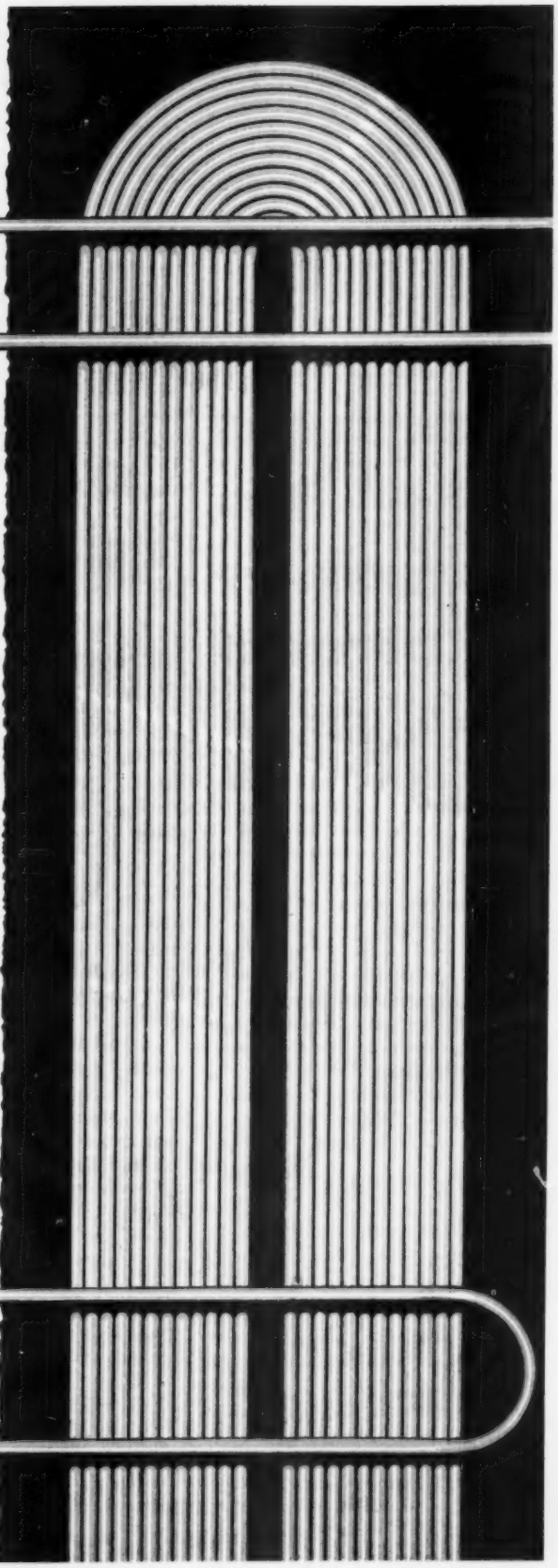
LEEDS & NORTHRUP CO. has received a contract from Baltimore Gas & Electric Co. for automatic load-frequency controls. The controls will regulate major generating units at the company's five steam stations and will control 1,197,000 kilowatts of generation.

PROGRESS REPORT on nuclear fuels and reactor materials development compiled by the AEC is now available through the Office of Technical Services, Business and Defense Services Administration, U.S. Department of Commerce, Washington.

PLAN IS HATCHING between four neighboring electric utilities in the Carolinas and Virginias to coordinate and pool their power production and transmission facilities. The companies are Virginia Electric and Power, Carolina Power & Light, South Carolina Electric & Gas, and Duke Power Co. These are the same four companies that joined together in 1956 to build the first atomic power station in the Southeast.

Vepco president, A. H. McDowell, Jr., says: "The basic pooling and co-

NEW FEEDWATER HEATER TUBE



provides high strength ... at lower cost

ANACONDA CUPRO NICKEL, 30%-707 provides important money-saving advantages over generally used feedwater heater tube alloys. Approved for condenser and heat exchanger use by the ASME Boiler & Pressure Vessel Code Committee, it offers highly desirable properties for power plant feedwater heaters . . . at lower initial cost.

A point-by-point comparison of mechanical properties is detailed in our Publication B-45.

Of course, this high-strength copper-nickel-iron tube alloy is only one of the many Anaconda alloys available for various types of heat exchangers. These include arsenical admiralty, red brass, 10% and 30% cupro nickels, phosphorized coppers, and Anaconda's own Ambraloys, Ambronze, and Everdur®.

For the complete story, ask your nearest Anaconda technical representative, or send for our 44-page Publication B-2 and Cupro Nickel, 30%-707 Publication B-45. Address: Anaconda American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ontario. 61-920

CUPRO NICKEL, 30%-707
Weldable
High Strength
Corrosion Resistant
Stress-corrosion Resistant

ANACONDA®
AMERICAN BRASS COMPANY

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ordination plan does not include the details for pooling capacity, coordinating transmission construction, or allocating the costs involved. However, it does designate the means of arriving at mutually agreeable plans and sets a time limit of January 1, 1963, for this to be accomplished. Plans also contemplate joint long-range planning of new construction —both for generating capacity and for transmission lines."

around the power circuit

NEW TEST CENTER for testing guyed V aluminum towers is being constructed by Michael Flynn Mfg. Co. of Philadelphia. Reported to be the only facility in the U.S. specifically built for testing guyed aluminum structures, the Flynn test center occupies an area of more than 50,000 sq ft and will be available to any utility company for testing.

The Flynn center will be set up to apply transverse loads, vertical loads, longitudinal loads, and broken wire loads representing a cable failure in service. Voltage range runs from 115 through 700 kv, and the center can test towers ranging in height from 50 through 120 ft.

U.S. CORPS OF ENGINEERS has awarded a $1.5-million contract to Worthington to supply Providence, R.I., with five giant pumps for use in conjunction with the nation's first hurricane dam.

The pumps are of the vertical propeller type, each measuring more than 20 feet in diameter and approximately 31 feet from end to end. They will be installed side by side, and combined will be able to pump more than 4½ billion gpd.

The Fox Point Dam, which is expected to be completed by 1964, will stretch 680 feet across the Providence River and will offer downtown Providence, which is below sea level, complete protection against raging storm waters.

INCORPORATED in the annual report of the World Bank and International Development Association was the emphasis placed on the international developments in the power field. Of 27 loans totaling $610 million made last year, eight, amounting to $125 million, were for electric power developments. Next to transportation, this is the largest single field. It is estimated that these loans will add more than one million kilowatts of capacity in Uganda, Ceylon, Japan, Colombia, Costa Rica, El Salvador, Norway and Yugoslavia.

SOUTHERN CALIFORNIA EDISON has filed an application with the California Public Utilities Commission for authority to construct a fourth unit at its Etiwanda steam-electric generating station near Fontana. Edison proposes to build another 310,000-kw generating unit at a cost of nearly $37 million.

NUCLEAR POWER PLANT that will be sited only 700 miles from the South Pole is the objective of negotiations between AEC and Alco Products, Inc.

Designated PL-3 (portable low power reactor No. 3), the plant will be assembled by Naval construction battalion seabees at the Byrd Station in the Antarctic and will be operated by the Navy after a testing program to be conducted by the AEC. It will be the second of the power reactors authorized by Congress in 1960 for the South Polar region. The Commission is currently procuring for the Navy a nuclear power plant for operation at McMurdo Sound in 1962.

The PL-3 will be used to provide electric power and steam for the station, which is a base for studies supported by the National Science Foundation. The plant will also produce steam to operate snow-melting equipment designed to provide an ample supply of fresh water at the site.

MIDWEST PIPING has been awarded a contract in excess of $1,100,000 for high-pressure, high-temperature steam piping in the new Ravenswood Plant of Consolidated Edison Company of New York. Operating at 1050 F and 2310 psi, the piping will be used in connection with two 363,000-kw turbines and two 2,500,000-psi boilers.

GULF STATES UTILITIES of Beaumont, Texas, is planning a four-year, $195-million construction program, of which about $46 million would be spent in 1961. During the 1961-65 period, Gulf States plans to put into service an additional 880,000 kw of generating capability. A new power station, with a capacity of 440,000 kw, is being built between Orange and Port Arthur, Texas, and two 220,000-kw generating units are to be installed in the Willow Glen station near Baton Rouge, La.

CONSTRUCTION HAS BEGUN on a $7-million extension to the international control dam on the upper Niagara River, a joint undertaking of Ontario Hydro and the Power Authority of the State of New York.

The existing 13-gate structure about one mile above the Falls was completed in 1957. It controls water levels in the Chippewa-Grass Island Pool—head pond area for Canadian and American generating stations—and regulates flow over the Falls.

Five 100-foot-wide sluices and gates will be added to the dam to maintain the required Pool levels and permit the safe passage of ice on the Canadian side.

EVERY MAJOR POWER installation in Moscow and its outlying areas will be using closed-circuit TV systems for monitoring instruments by 1965, if the present plans of Soviet authorities develop according to schedule, a Moscow technical journal reports. But an anticipated "significant improvement" in Soviet telemetering techniques is contingent upon effort to overcome the USSR's current lag in constructing radio-relay lines, the Russian periodical *Electric Power Stations* notes.

The report from *Electric Power*

Continued on page 80

Hall Industrial Water Report

VOLUME 9 NOVEMBER 1961 NUMBER 5

Questions with/without answers

Why does equipment fail from corrosion? Why do water-formed deposits interfere with production? Why is a process unpredictably upset by water conditions? Why are *complete* plant water surveys essential to the solution of waste disposal problems?

It is a rare company that is staffed to answer questions like these or to tackle all of the troubles that are due to water. That is why the services of Hall engineers are in demand. They are ready to supplement your staff in solving water problems whether they are associated with steam generation, cooling, process water or waste water disposal.

Mysterious hardness

On studying water analyses from a metal fabricating plant, Hall field engineer J. F. Nelson found a puzzling situation. Some condensate samples contained about five times as much hardness as the make-up water and about twenty times as much as the boiler feedwater.

Nelson explained the obviously impossible condition to the plant engineer. They decided to make a quick survey. When they arrived at the location where the samples were collected, Nelson noticed that there was a lot of dust in the air. The dust was lime. Condensate samples were sometimes contaminated with lime during collection.

Analytical results are only as good as the samples. You may be sure no more contaminated condensate samples will be collected in this plant.

Condenser leaks quickly located

The engineer in a machinery plant wanted a quick way to inspect a condenser for leakage. He consulted Hall field engineer J. A. Gregory, who recommended the use of fluorescein dye in the water used to fill the condenser. When ultraviolet light is directed onto the tube sheet, leaks are easily located due to the brilliant fluorescence of the dye.

Gregory's suggestion paid off. The plant engineer happily reported that the inspection was completed in thirty minutes. Formerly, two skilled workers had worked for four hours to do the same job. The only expense involved was a few dollars for an ultraviolet lamp and enough dye to permit several inspections.

Clear water

The aquarium tank is 82 feet in diameter and 17 feet deep. Visibility is limited to 1-2 feet by suspended matter in raw Gulf of Mexico water. Obviously, excellent clarification is necessary so that visitors can see through the water.

Hall field engineer D. E. Speeg recommended the use of a Hagan coagulant aid in the clarification process. It speeds up the coagulation of suspended materials and produces a rapid flotation—floc is then removed by flooding the treating tanks from beneath the surface.

Results: Increased filter runs, minimum cost for chemicals and labor, and clear water.

Nonadhesive glue

A manufacturer of multiwall bags was in serious trouble with glue that didn't stick. Suspecting water conditions, he called Hall field engineer C. A. Blanck for help.

Condensate was used for preparation of glue. Blanck's quick analysis showed the condensate to be quite alkaline, to contain phosphate and to be high in dissolved solids. This meant there was contamination of condensate with boiler water because of carry-over.

Boiler water samples were analyzed. Results showed excessive dissolved solids concentrations. Heavy blowdown, followed by a daily testing program for control of boiler water conditions, cleaned up the condensate. The glue is sticky again.

Well plugged

All of the water for a small chemical plant was supplied from one well. When the capacity dropped forty percent something had to be done.

The operators told Hall field engineer S. B. Dilcer about their trouble. He recommended cleaning the well with sodium hexametaphosphate (Calgon®). Capacity of the well returned to normal.

Needless to say, plant men were pleased. They had found an easy and cheap solution to a problem they thought would involve considerable expense for major pump repairs, a new pump or even a new well.

Want more information?

The many ways industry can use Hall Laboratories industrial water consulting services are described in a 24-page brochure.

For your copy, write on your letterhead to:

HALL LABORATORIES
HAGAN CENTER, PITTSBURGH 30, PA.
Consultants on Procurement, Treatment, Use and Disposal of Industrial Water

DIVISION OF **HAGAN** CHEMICALS & CONTROLS, INC.

For more data circle 504 on Post Card

who

Joseph Delano Hitch, Jr., has been appointed general manager, international sales, of Babcock & Wilcox Co.'s boiler division. Hitch is former president and chairman of the board of Dorr-Oliver, Inc.

Russell R. Wischmeyer has become vice-president in charge of construction of Pittsburgh Piping and Equipment Co.

D. W. R. Morgan, Jr., has been appointed manager of the steam system engineering department for the Westinghouse steam division. Morgan was graduated from Harvard University in 1944 with a degree in engineering sciences, and joined Westinghouse the same year.

Executive vice-president **Harold L. Durgin** of Central Vermont Public Service Corp. has been named president to succeed **Albert A. Cree**, who was elected to the new position of chairman of the board and chief executive officer. The board of directors also named **Wayne M. Edson** vice-president, operations and construction, and **Robert B. Schill**, vice-president, marketing. **Howard S. Lewis** was promoted to chief engineer and placed in charge of the newly formed division of engineering and planning.

Charles R. Landrigan, executive vice-president of the Detroit Edison Co., has retired after almost 49 years with the company.

Prof. Gordon A. Hellman, of the Mechanical Engineering Dept. of Michigan College of Mining & Technology, has been promoted to the position of superintendent of the college physical plant.

A. B. Mindler has been appointed to the newly-created post of manager of special applications sales for the Industrial Division of the Permutit Co.

C. E. Bitzer has been appointed vice-president, marketing, for G&W Electric Specialty Co.

Two new vice-presidents have been named for Aqua-Chem. They are **R. W. Goeldner**, as vice-president of engineering; and **R. I. Preuit**, as vice-president of government sales and service.

Park R. Lawson of Pennsylvania Electric Co., Johnstown, has been elected president of the Pennsylvania Electric Association.

John Fritz Medal for 1962 goes to **Crawford H. Greenewalt**, president of E. I. du Pont de Nemours & Co.

Harold Grasse has joined Henningson, Durham & Richardson of Omaha as head of the mechanical engineering department. Grasse has been associated with the consulting engineering firm of Black & Veatch, Kansas City, for 22 years.

At Allis-Chalmers, **Webster J. McCormack** has become assistant sales manager, turbines, York Works. **Dane T. Scag** has been appointed assistant director of research.

Donald W. Devine has been named manager, personnel development, and **Francis Sanfilippo**, manager, wage and salary administration, for the Babcock & Wilcox staff division.

what

Theme for the 1962 National Engineers' Week, February 18-24, is "Economic Growth Through Professional Engineering." The annual observance will be the 12th under the general sponsorship of the National Society of Professional Engineers.

Research scientists at Allis-Chalmers are now using ammonia as fuel in the cells that produce electricity through chemical reactions. Earlier experiments used hydrogen, hydrazine, methanol and other fuels.

Advantages of the ammonia fuel cell, according to reports, are that ammonia is low in cost when purchased in large volume, is easily condensed, and storage, transportation and handling techniques already have been worked out for ammonia used in large quantities.

when

American Nuclear Society, the Atomic Industrial Forum, Atom Fair and the National Youth Conference on the Atom are meeting in Chicago the week of Nov. 6-10.

35th annual meeting of the National Electrical Manufacturers' Assn. will be held Nov. 16 at the Plaza Hotel in New York City.

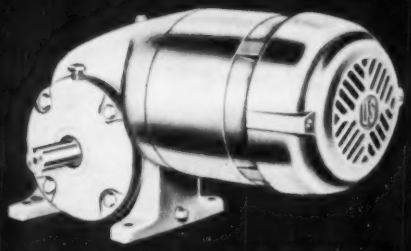
ASME Winter Annual Meeting is set for Nov. 26-Dec. 1 at the Statler-Hilton Hotel in New York City.

Power Engineering Seminar, first of its kind in Canada, will be held Dec. 7-9 in Toronto's Queen Elizabeth Bldg., Exhibition Park. It's a feature of Canada's Power Show.

ASME Second Symposium on Thermophysical Properties will be held Jan. 24-26, 1962, at Princeton University.

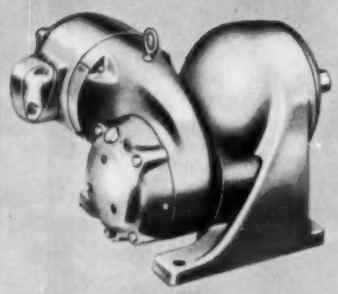
AIEE's Winter General Meeting and Exposition will be held Jan. 29-Feb. 2, 1962, in New York City.

COMPACT, LOW-SPEED POWER...

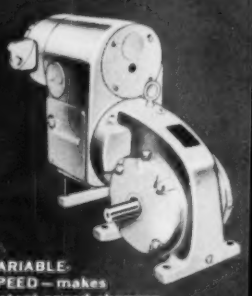


TOTALLY ENCLOSED—for corrosive dust, salt, spray and other damaging environments—provides slow speeds for applications in which ordinary motors require frequent replacement.

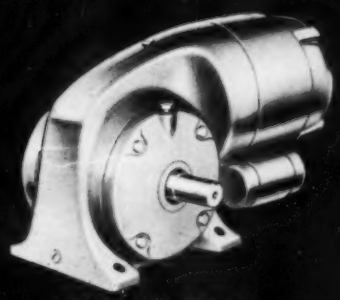
EXPLOSION-PROOF—for volatile fume, explosive dust atmospheres—provides genuine explosion-proof characteristics for hazardous environments. Underwriters' Laboratories approved for Class 1 Group D and Class 2 Groups F and G.



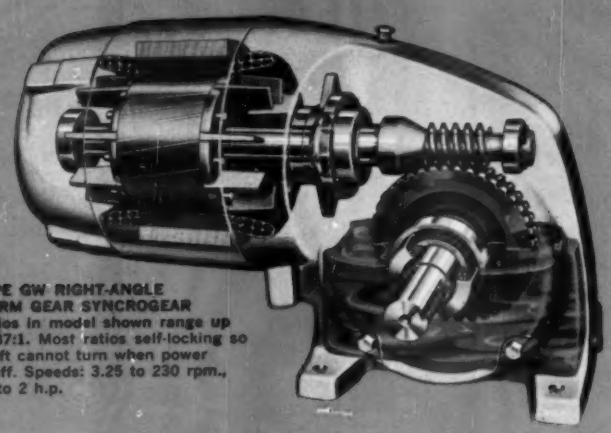
DOUBLE-REDUCTION (GWB)—ratios up to 354:1—with second stage helical gear train—provides steady, multiplied torque and extremely slow speeds for applications in which power-speed precision is important. High-torque case is constructed to resist extra pull.



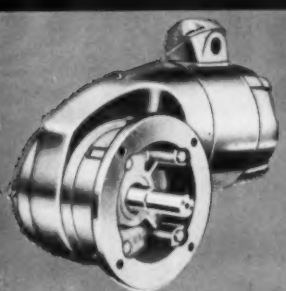
VARIABLE-SPEED—makes instant speed changes by merely turning dial—Combination of GW Syncrogear with U.S. Varidrive Motor to provide speed control with worm-gear reduction.



SINGLE PHASE (GWR)—can be connected to any 110 or 220 volt line—equipped with capacitor. Single phase is available from ⅓ to 1½ h.p. Single phase is also available in double-reduction Type GWB-R.



TYPE GW RIGHT-ANGLE WORM GEAR SYNCROGEAR
Ratios in model shown range up to 87:1. Most ratios self-locking so shaft cannot turn when power is off. Speeds: 3.25 to 230 rpm., ⅓ to 2 h.p.



FLANGE-MOUNTED (GWV)—for direct connection to driven machine—Footless. Can be direct-connected vertically or on side with shaft right or left.

U. S. SYNCROGEAR/right-angle, worm-gear type

The most economical gearmotor is the right-angle worm-geared type, and it is often the most logical choice for compactness. U. S. SYNCROGEAR MOTORS, Type GW, offer you such features as compact, strong pyramidal construction and rugged cast-iron case, providing rigidity to handle overhung loads, high starting torques; U. S. Motors' own precision-made gears; one-piece motor worm-gear shaft eliminating connection of motor and worm shafts; and no-rib construction for easy cleaning. Available ⅓ to 2 h.p. For trouble-free operation... long life... specify: U. S. SYNCROGEAR MOTORS, RIGHT-ANGLE WORM-GEAR TYPE.

U.S. ELECTRICAL MOTORS INC.

Los Angeles 54 (P.O. Box 2058), California — Milford, Conn.

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Newest member of Hagan's complete Power Positioner line–

HAGAN 2½" x 5" POWER POSITIONER

This little gem is new, but already over 500 of them are at work in a number of applications where accuracy, speed and power are requirements.

The 2½" x 5" has the following specs:

Positioning accuracy	1%
Frequency response	1.0 cps @ 10% peak to peak input 0.5 cps @ 5% peak to peak input
Full stroke time	Less than 2 seconds
Power air	100 psig max., 45 psig min.

It also shares these common characteristics with the rest of the Hagan line: design simplicity, rugged construction, minimum maintenance requirements and high positioning stability. Unit is compact, easily adapted for valve mounting and large port areas minimize plugging problem on poor air systems.

For complete information, write or phone for specifications sheet TP22550.

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CHEMICALS & CONTROLS, INC.
HAGAN CENTER, PITTSBURGH 30, PENNSYLVANIA

HAGAN DIVISIONS: CALGON CO. • HALL LABORATORIES • BRUNER CORP

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versatility...

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BOILER FEED SERVICE In the high pressure-high capacity range—conventional and high speed barrel type units. In the moderate capacity and pressure range—heavy duty horizontally-split case multi-stage pumps and unitized Steam Turbopumps.

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Investigate the full line of Pacific centrifugal pumps for efficient, economical pumping in your steam generating plant.

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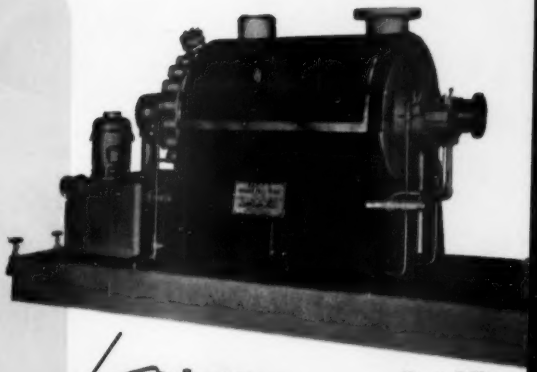
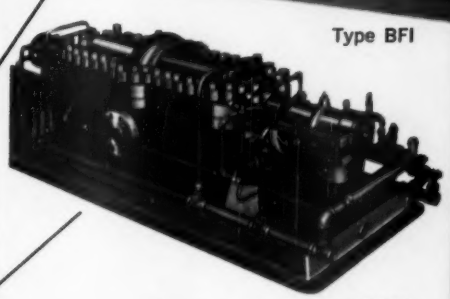
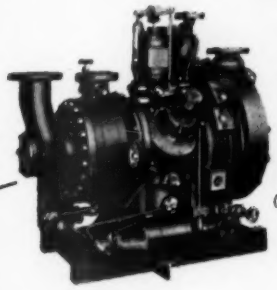


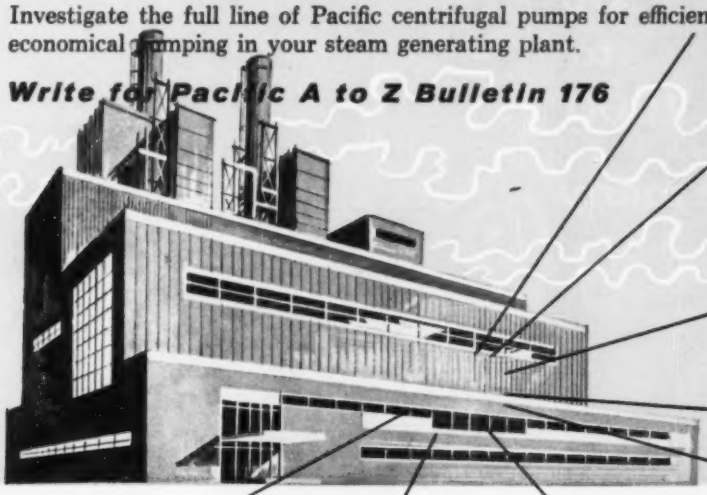
Type BFI

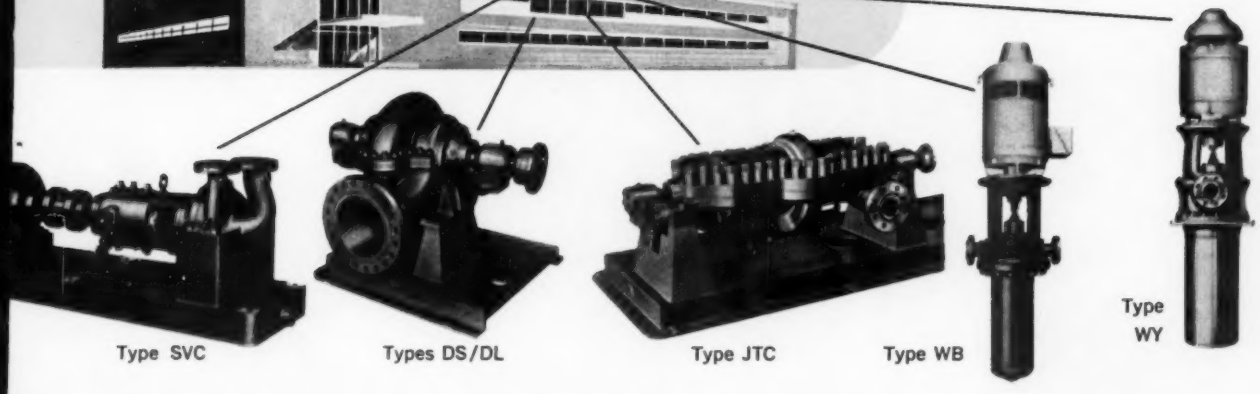


Type BFJTC



Type TBA
(Steam Turbopump)





Type SVC | Types DS/DL | Type JTC | Type WB | Type WY

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CENTRIFUGAL PUMPS FOR PETROLEUM, CHEMICAL, UTILITY, MARINE & GENERAL INDUSTRIES • OIL WELL PUMPS

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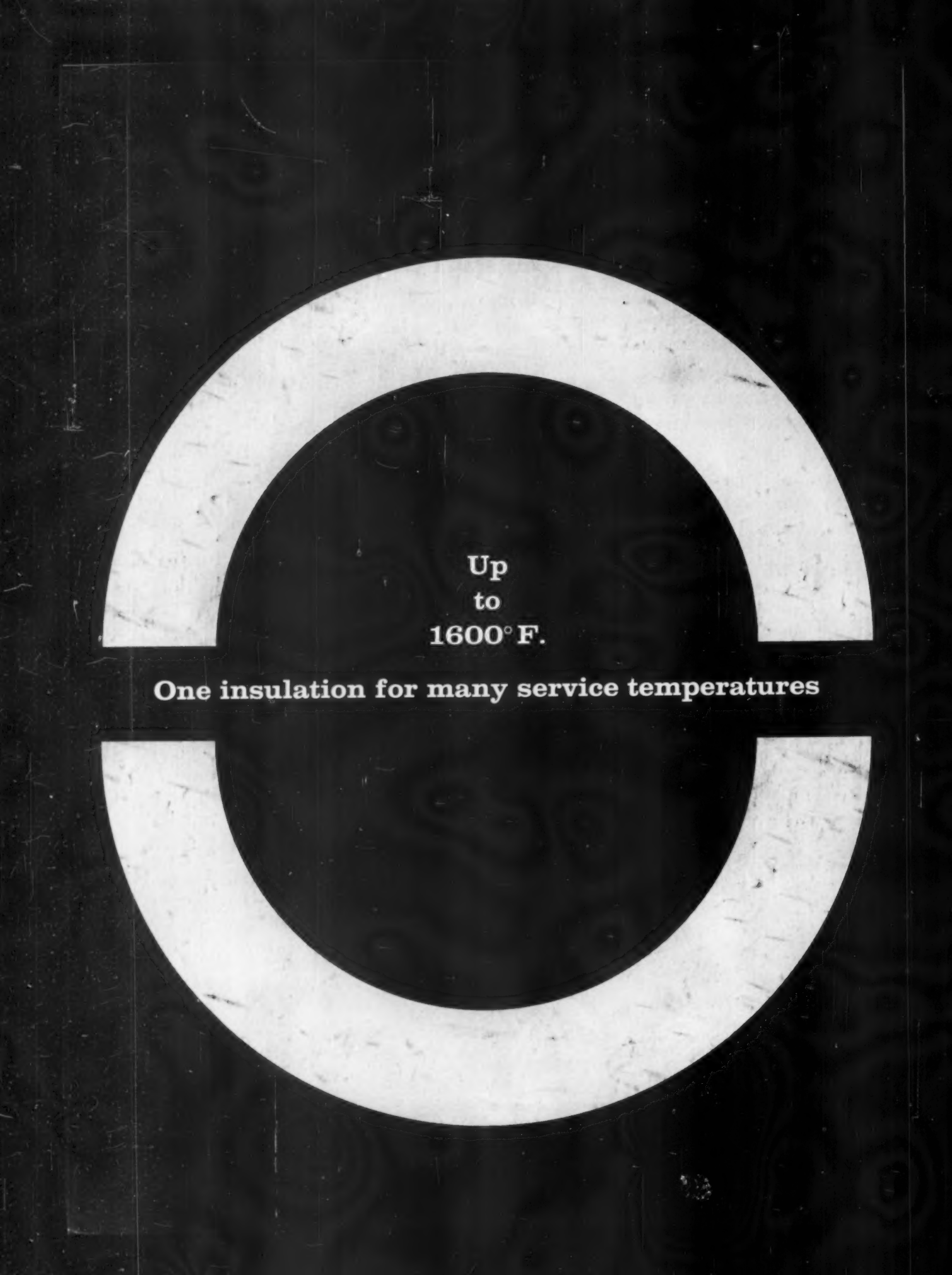
Up
to
1600° F.
One insulation for many service temperatures

This is Careytemp®

Composition
A new pipe and block insulation material . . . millions of glassed-in air cells of expanded silica bound together, reinforced with inorganic fibres. Gives exceptional strength, yet is lighter than other industrial insulations. Density: 9 lbs. per cu. ft.

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Absorbs practically no moisture. Minimum efficiency loss under wet or humid conditions.

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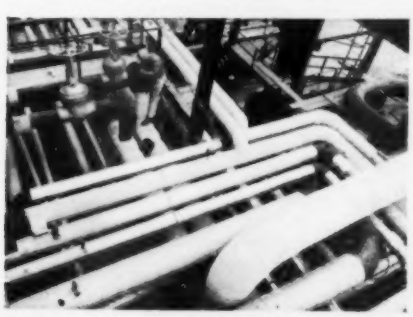
Practically no linear shrinkage, even at high temperatures (0.7% at 1200° F.). Minimum heat loss at joints.

Low Thermal Conductivity
Only .33 B.T.U./sq. ft./hr./°F. at 100° F. — .77 at 1000° F. mean.

High Acid & Corrosion Resistance
Improved performance on acid-processing and stressed stainless steel equipment. Not damaged by most acids. Chemically-inert composition ideal where corrosion is a problem.

Wide Size Range
Available in larger labor-saving sizes. Blocks in new 24" widths and pipe insulation in half sections through 24" pipe size.

Over four years of field use have proved Careytemp, following thorough laboratory testing at Mellon Institute of Industrial Research. For Careytemp samples and additional specifications, write Dept. PW-1161, Insulation Division, The Philip Carey Mfg. Company, Cincinnati 15, Ohio.



Sohio Chemical Company, Lima, Ohio. Careytemp specified exclusively to cover the wide range of temperatures encountered in this modern chemical processing plant.

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How Empire State Building and American Airlines solved vital fire protection problems with EVERLASTING VALVES

102 stories, 1,472 feet high, 16,000 tenants and 35,000 visitors sum up the fire protection problem of the Empire State Building. An in-building fire protection system is necessary to an unfailing water supply.

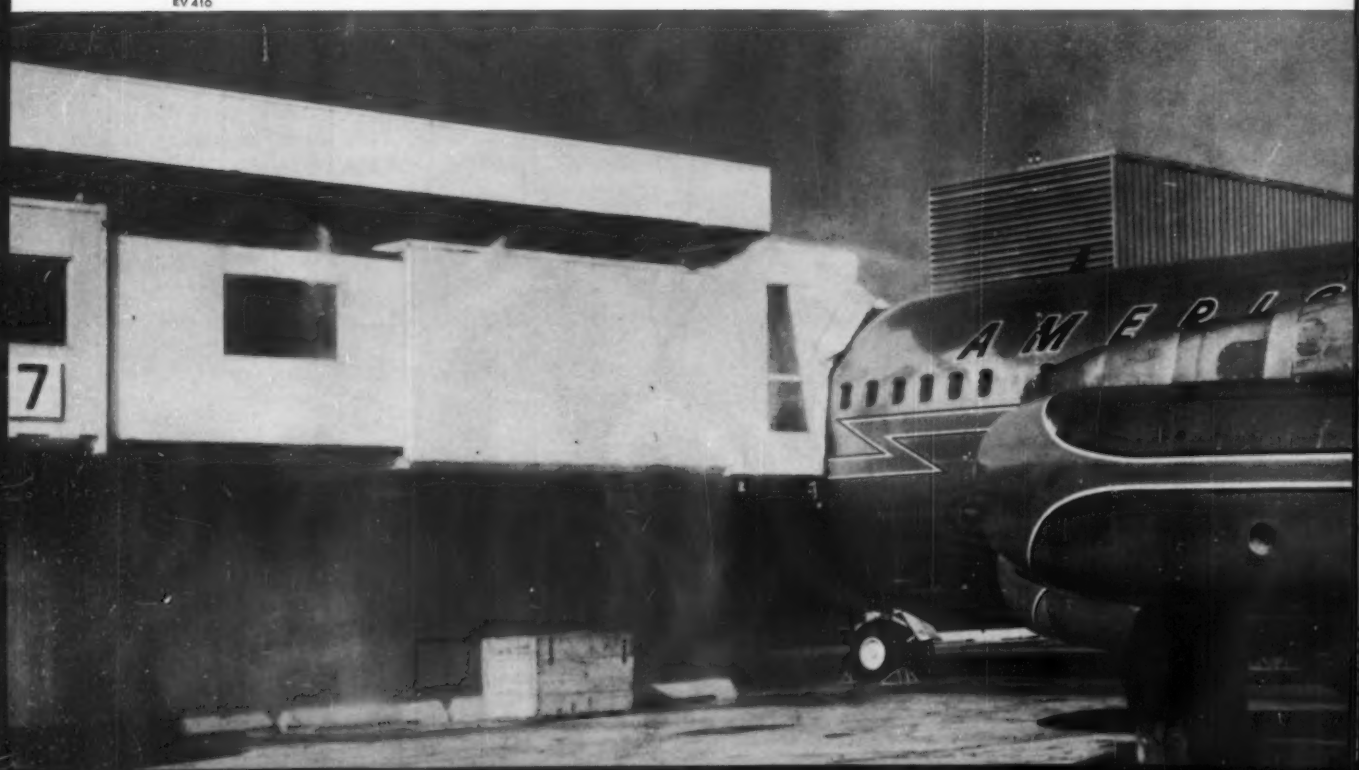
American Airlines loading bridge, shown below, gives passengers positive protection against fire with a unique deluge system.

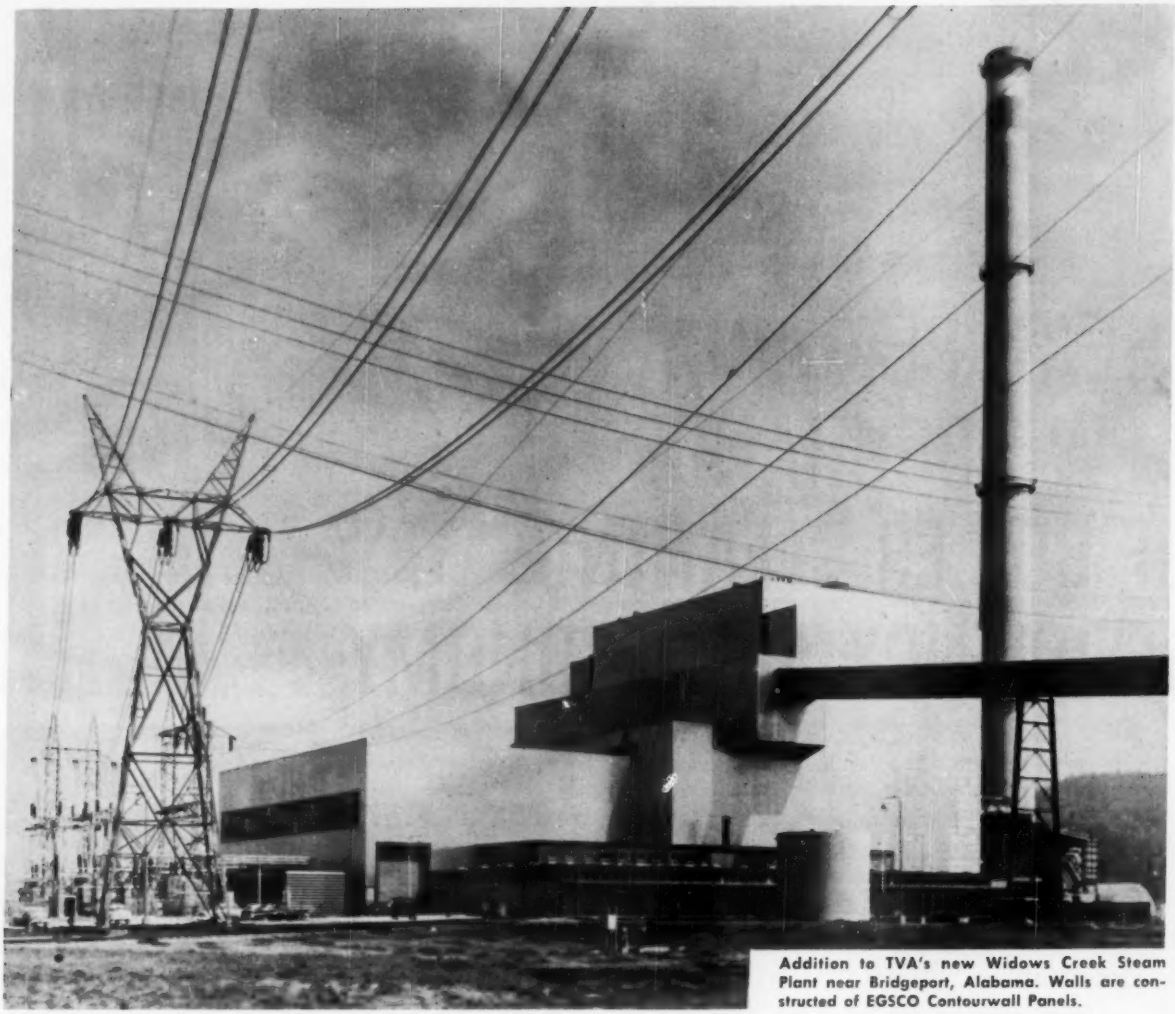
Both these fire protection systems depend on Everlasting Pendulum Stop Valves, which have been installed in thousands of critical fire protection systems over the past 35 years.

For complete information on the unique American Airlines and Empire State Building systems, write for bulletins F. They include an editorial description of both these installations and a bulletin describing Everlasting's positive action pendulum stop valves.

Everlasting also makes a line of quick-opening valves for general service, boiler blow-off, and handling viscous materials, as well as a line of cylinder-operated valves. Bulletins on all these valves are available. **Everlasting Valve Company, 47 Fisk Street, Jersey City 5, New Jersey.**

EV 410





Addition to TVA's new Widows Creek Steam Plant near Bridgeport, Alabama. Walls are constructed of EGSCO Contourwall Panels.

When you're faced with a huge power plant cover problem—

look to the economy of EGSCO® insulated metal walls!

Large wall areas go up quickly and securely by the EGSCO method of wall construction that substantially cuts erection man-hours. Whether of aluminum, aluminized steel, or galvanized steel, you get a sound, durable wall with ample insulation and baked-on protective enamel with your choice of architectural color.

The structural strength of EGSCO Wall Panels reduces your steel framing costs, too, because their allowable longer span reduces the necessary number of steel girts.

For complete information and specifications for EGSCO Wall Panels, write for Bulletin 62W.

Also available to architects and engineers is the new Catalog of Standard Details, from which scale prints may be selected and requested as needed to assist in construction plans and engineering specifications.

ELWIN G. SMITH & CO., INC.

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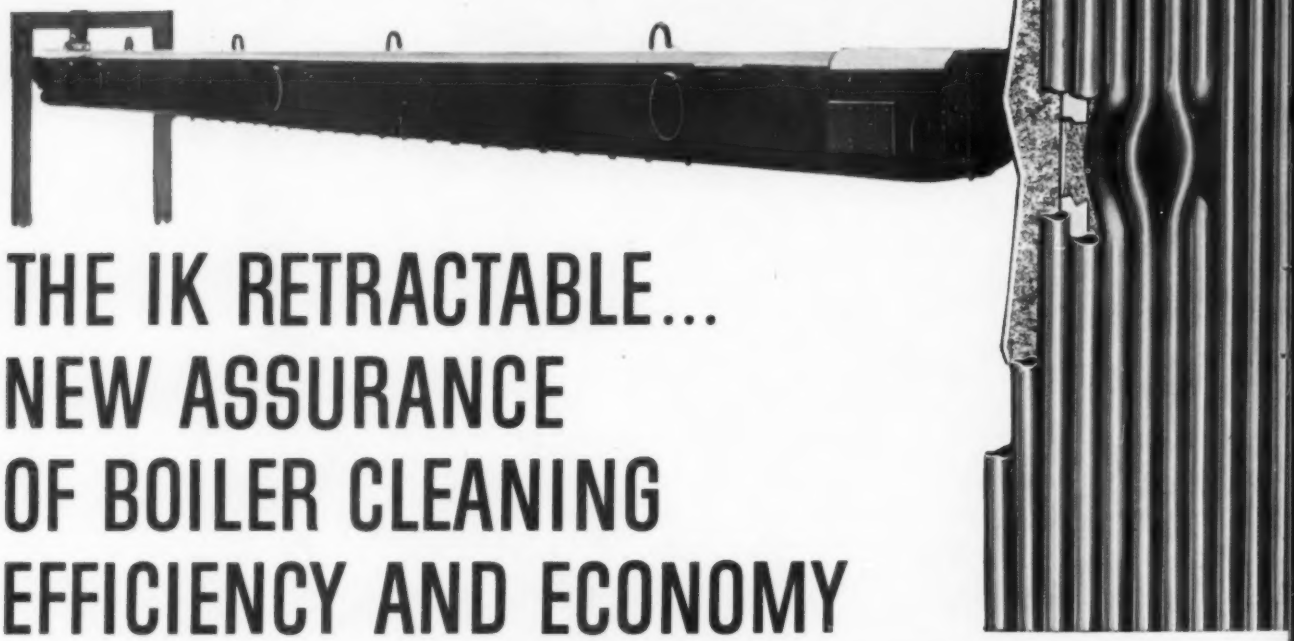
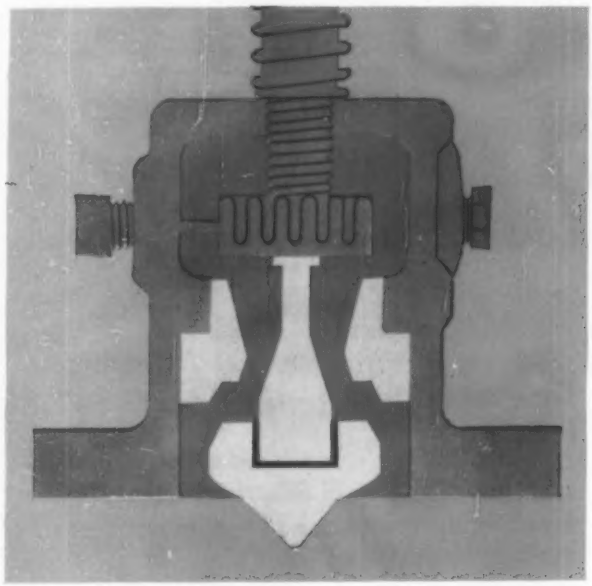
Diamond developed for more economical power...

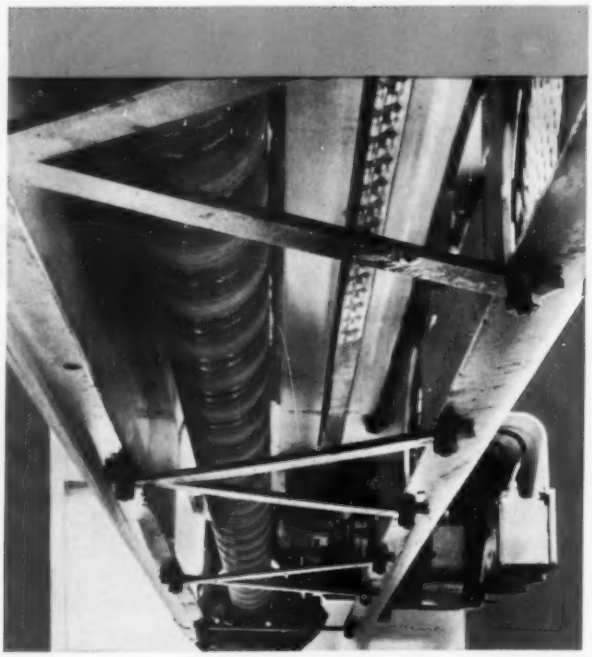


THE IK RETRACTABLE... NEW ASSURANCE OF BOILER CLEANING EFFICIENCY AND ECONOMY

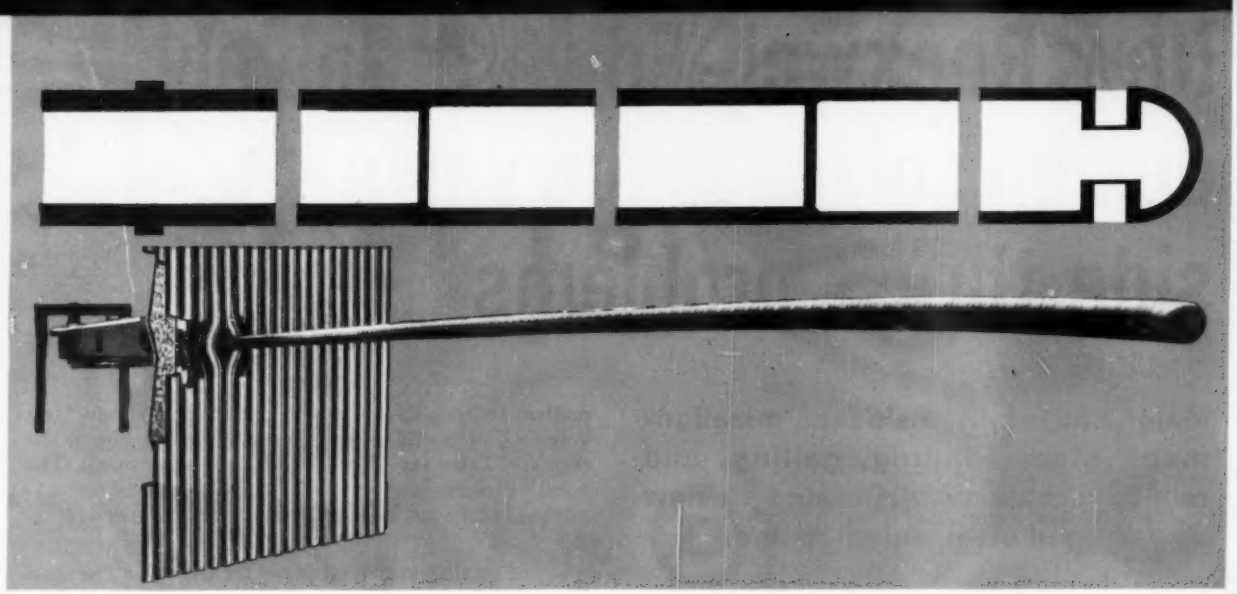
For years . . . in thousands of boilers . . . the Diamond IK Long Retractable Blower . . . with its close-cleaning helix, positive rack-and-pinion drive and single motor . . . has provided maximum cleaning effectiveness at lowest possible cost. Now, thanks to seven new major design improvements, the IK assures even better performance. Examine them carefully and you'll soon see why.



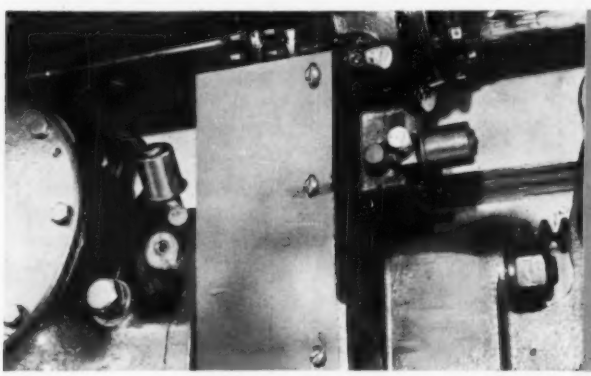
1 Minimizes valve leakage problems . . . flexible valve arrangement. In most valves, differentials in valve body temperatures produce distortion which causes leakage. In the new IK valve, this problem has been solved. Critical valve internals expand and contract *with* temperature changes, thereby eliminating distortion and drastically reducing the possibility of costly leakage.

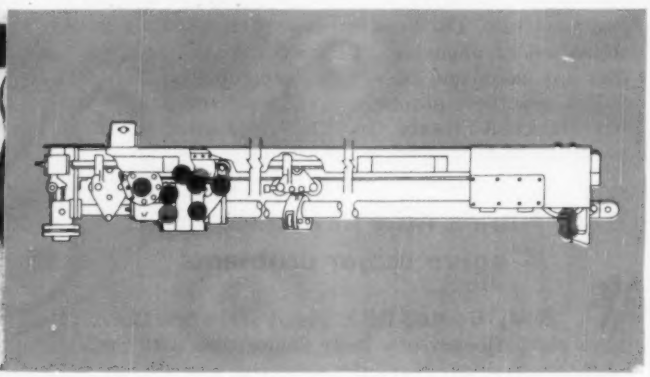


2 Ample coverage to clean the biggest boilers . . . box-type beam. For cleaning coverage over 34 feet, the Diamond IK Series 400 features a new box-type beam construction. This design retains the simplicity and convenience of two-point blower support with 6 inch trolley beam, yet assures ample strength and rigidity for stable, uniform lance travels to 42 feet and over. It also improves blower appearance and provides protection during installation. (Note: The evenly spaced roller marks on the retracted lance attest to the IK's exclusive "every inch" cleaning helix. It's your assurance of uniform, complete cleaning . . . *regardless* of tube bank arrangement and tube spacing.)



3 **Reduced lance deflection and less wobble for longer travels . . . stronger lance.** To minimize lance deflection where cleaning coverage is over 34 feet, Diamond uses a 3¼″ O.D. lance instead of a 3½″ O.D. lance. To further reduce lance deflection, the standard Diamond step-tapered lance tube construction is used. This rigid construction combined with the heavier lance support and box-type beam enclosure used on the Series 400 blower, assures stable lance travel and effective, uniform cleaning . . . for furnace coverage to 42 feet and over.





4 **Mini-Lube . . . slashes need for maintenance manpower with once-a-year lubrication concept.** To reduce costly blower lubrication, the number of lubrication points on the new IK has been cut from eighteen to only eleven. What's more, frequency of lubrication is greatly reduced . . . for instance, blowers operated three times daily should not require lubrication more than once a year. Figure it out! Mini-Lube can save thousands of dollars yearly in maintenance costs; helps keep your IK's in peak operating condition with minimum attention. (Photo shows some of the easily accessible lubrication fittings; the schematic drawing shows all of the lubrication points).

---

5 **Multi-speed drives . . . less blowing medium . . . less cleaning time.** A considerable reduction in cleaning cycle time with consequent reduction in blowing medium requirements (up to 25% savings) can be achieved through proper application of 2-speed electric motor drives.*

6 **Less stack emission by spaced blowing.** More frequent but shorter cleaning cycles can be used in easy-to-clean zones. For any single cleaning cycle, this means a significant reduction in stack emission.

7 **Insulated feed tube . . . reduced packing maintenance with steam blowing.** A double-tube construction, with insulating air space between the two tubes, minimizes frequency of replacement of packing and shows significant savings compared with single-tube construction, for blowing steam temperatures of 750F and over.*

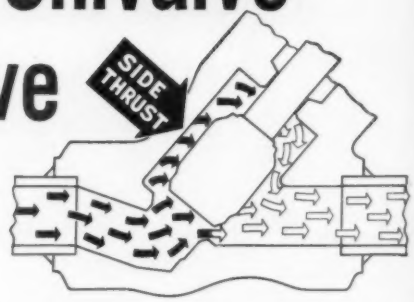
For most effective cleaning of pendant and horizontal tube surfaces the Diamond IK Long Retractable Blower is your assurance of unmatched performance and economy. Call, write, or wire for complete information.

**Available at slight additional cost.*

DIAMOND POWER

DIAMOND POWER SPECIALTY CORPORATION, Lancaster, Ohio
DIAMOND SPECIALTY LIMITED, Windsor, Ontario

New Rockwell-Edward Univalve* design solves globe valve side thrust problems



Major causes of disk-seat misalignment, stem bending, galling, and related problems eliminated in new forged steel Univalve line.

Now, through a unique body-guided disk construction, Rockwell-Edward research engineers have solved the major globe valve problems inherent in modern high-energy-loss piping systems.

High velocities and high pressure-differentials have a damaging effect on forged steel globe valves in throttling, blow-off, drain and similar services. Conventional stem-guided disks are forced out of alignment and don't seat positively. The same forces bend even the strongest stems out of alignment. Contact areas on disk, seat, disk-nut, stem and bonnet become galled and scored.

But now these problems have been overcome by the new Rockwell-Edward Univalves. And other perennial problems have been solved at the same time.

Here's how new Univalves solve major problems

1. **Body-Guided Disk.** Heart of the new Univalve is its revolutionary new body-guided disk with Stellite anti-thrust rings. Not only does the new design and construction do a perfect job of guiding the disk into the seat but, even more important, it eliminates as much as 90% of the side thrust that *causes* misalignment!

The close fit of the lower Stellite disk guide ring within the body bore virtually eliminates the problem of upstream-downstream pressure differential that can force the disk and stem out of alignment. Remaining forces that could cause misalignment are easily controlled by the inter-action of the two widely separated guide rings.

Use of Stellite for guiding and contact surfaces provides maximum protection from erosion, galling and oxidation, as well as from scratching and cutting by foreign material in the line. Results: a valve that can be opened and closed repeatedly in high pressure loss services with merely a superficial polishing of contact surfaces.

2. **Improved disk-nut lock.** Instead of merely tack welding the disk to the disk-nut, Edward now employs a more expensive but virtually fool-proof method to keep these parts together. In the new Univalve a hole is drilled through the upper portion of the disk and, after assembly, is filled with weld metal. The bond is permanent, yet disassembly can be accomplished easily by merely drilling out the weld plug.

3. **Special stem surface treatment.** The new Univalves of larger size have stems coated with molybdenum disulfide. This process endows the stem with remarkable lubricating and anti-galling properties. Life of stems and all adjacent parts is extended. Operating torque is reduced.

4. **Easy-to-locate body-bonnet seal-weld.** Extended vertical and horizontal surfaces of both bonnet and body provide clear definition of seal-weld dimensions. This facilitates the machining or scarfing required to remove the weld metal when disassembling the valve.

These and other refinements (like the Stellite backseat contact in many sizes and Stellite stem-disk bearing in all sizes) combine to produce a new Rockwell-Edward Univalve line that is easier to operate and gives maximum valve life.

More body styles (see box at right) offer additional advantages. The vertical stem globe design, for example, can readily be installed with its stem projecting through a panel board. Or, it can be used with an extension stem for certain inaccessible locations.

And, where flow requirements are less rigid, the new Univalve line offers the "K" series. These reduced-port valves, available at lower cost than full-port units, provide full Univalve life and ease of operation for applications where flow capacity is secondary to other considerations. "K" series Univalves have flow capacity equal or superior to most similar competitive valves.

The new Rockwell-Edward Univalve line is available with screwed, socket, or butt weld ends, and with your choice of loose or integral backseats. For more detailed information, ask your Edward Representative for a copy of Catalog 14-U, or write Edward Valves, Inc., 1202 W. 145th Street, East Chicago, Indiana. Subsidiary of Rockwell Manufacturing Company. Represented in Canada by Lytle Engineering Specialties, Ltd., 438 St. Peter Street, Montreal. 6105

*T.M. Reg. U.S. Pat. Off.

EDWARD STEEL VALVES
another fine product by
ROCKWELL

For more data circle 512 on Post Card

New Univalves available in all these types

BASIC DATA

Body Material—forged chrome-moly steel
Sizes—½ inch to 4 inches

Basic Ratings—

1500 psi at 1050 F (3600 psi at 100 F)
2500 psi at 1050 F (6000 psi at 100 F)
4500 psi at 1050 F (10,800 psi at 100 F)

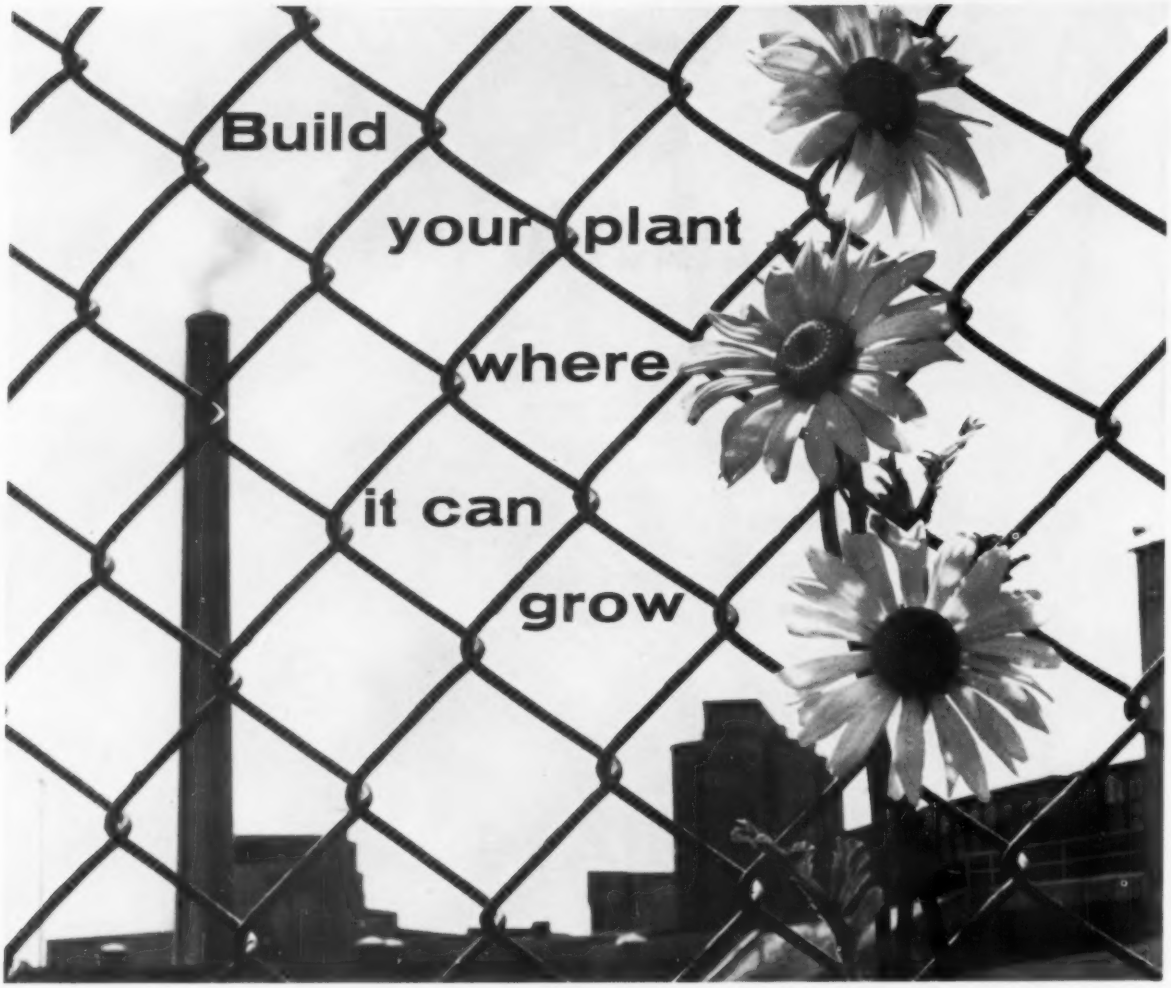
Vertical or Inclined (Y pattern) Bonnet
Screwed, Socket Weld or Butt Weld Ends

1. Inclined bonnet globe stop (or stop-check).

2. Angle body stop

3. Vertical bonnet globe stop

4. Piston check (horizontal or vertical)



Select A Site Near PEABODY'S Two-Billion-Ton Coal Reserves For Economical Power Far Into The Future

When you select a new plant site, plan for long-range growth by locating near Peabody's two-billion-ton coal reserves and modern mines . . . served by economical water transportation and major trunkline railroads . . . offering favorable shipping rates for raw materials and finished products.

Peabody's big, fully mechanized mines and tremendous reserves assure low-cost power for your plant and long-range insurance for your investment in capital equipment. Let Peabody help you select your new plant site . . . a site where *your* business can *grow*.

Learn more about the location of Peabody's 25 modern mines and river dock loading facilities. Write Industrial Development Division, Department PE.

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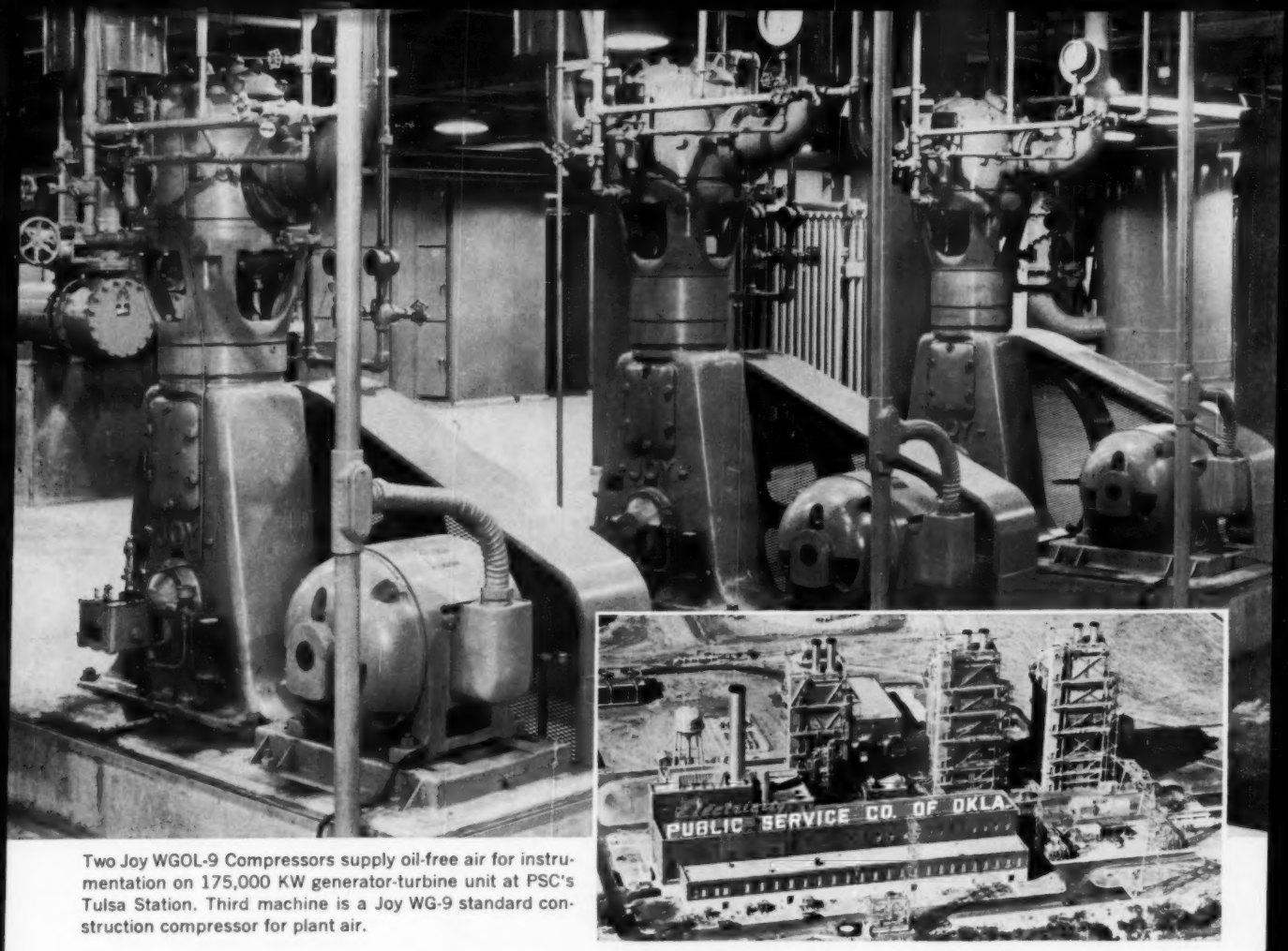


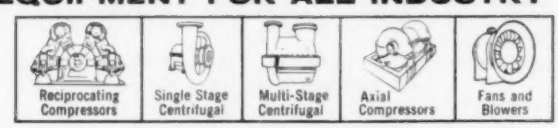
Two Joy WGOL-9 Compressors supply oil-free air for instrumentation on 175,000 KW generator-turbine unit at PSC's Tulsa Station. Third machine is a Joy WG-9 standard construction compressor for plant air.

Good experience with earlier machines prompts Public Service Co. of Okla. to install third group of Joy compressors since 1955

When the ultra-modern Northeastern Station of Public Service Company of Oklahoma goes on the line in 1961, both instrument and plant air will be provided by a battery of Joy Compressors. Two WGOL-9 machines will supply oil-free air, and two standard construction WG-9's will provide the plant air. These machines represent the third order for Joy's vertical type compressors in six years—evidence that this progressive utility has had good results from the earlier purchases.

The Joy WG-9 Vertical Compressors are particularly well suited for generating station applications. They offer heavy duty compressor features such as force-feed lubrication, replaceable cylinder liners and crosshead guides and heavy frame construction, yet their size and capacity range makes them economical for power plant service. Oil-free and standard air machines are almost identical in construction, which facilitates maintenance. Consult your Joy representative the next time you are expanding your air supply. He can furnish reliable oil-free or standard air compressors from 10 to 2000 hp. For complete details on the Joy WG-9 and WGOL-9 Compressors, write for Bulletin 2552-56C.

AIR MOVING EQUIPMENT FOR ALL INDUSTRY



JOY

Joy Manufacturing Company
Oliver Building, Pittsburgh 22, Pa.

In Canada: Joy Manufacturing Company (Canada) Limited, Galt, Ontario

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Steam trap dependability is a matter of what the manufacturer puts into the trap

ARMSTRONG TRAPS ARE DESIGNED AND MADE TO GIVE YOU DEPENDABILITY

1. Efficient, proved operating principle

Armstrong Traps provide the most advanced development of the time-proven inverted bucket principle. Simple, but effective, there isn't much that can go wrong.

2. Good design

Armstrong Trap design gives big capacity in a small package. The mechanism is virtually fool-proof. All body styles are easy to inspect and maintain without removal from the line.

3. Highest quality materials of construction

Only the best goes into Armstrong Traps. Bodies are close grained 30,000 tensile iron castings or high quality forgings. Working parts are all tough, corrosion resistant stainless steel.

4. Good workmanship

Armstrong Traps are made by craftsmen who take pride in their work. Careful inspection and frequent checking insure the quality of the trap.

5. Application know-how

Your problem has probably been solved already in the extensive experience of the Armstrong engineering and sales organization. You can be sure of sound, dependable recommendations.

Your local Armstrong Representative can show you what Armstrong dependability can do for you. Call him today or write direct.

860 Series for low pressure heating service.

800 Series, side inlet, side outlet.

No. 801, side inlet, bottom outlet.

880 Series, integral strainer.

200 Series, bottom inlet, top outlet.

Forged Steel Series for high pressures, high temperatures.

The 48 page Armstrong Steam Trap Book tells how to correctly size, install and maintain steam traps for any pressure, any temperature, any load plus full catalog data on Armstrong Steam Traps. Ask for Catalog K.

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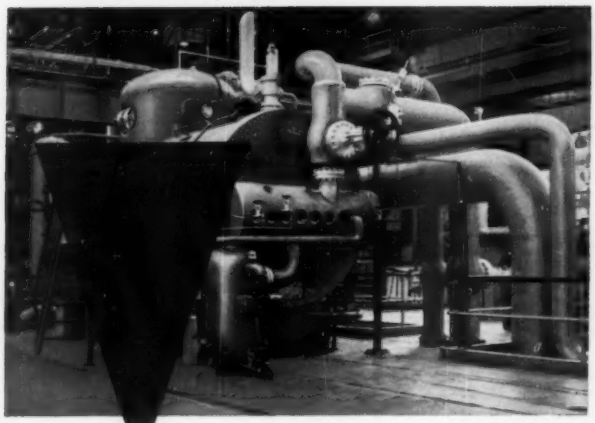
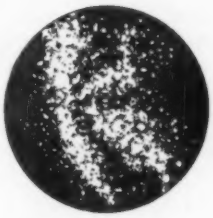


WHEN INDUSTRY NEEDS WATER



PURER THAN THE DRIVEN SNOW

Yuba Evaporators are achieving new record high purities

In power, processing, marine or any industry that needs high purity water in volume, Yuba evaporators are recognized as the finest equipment available today. There are good reasons why. Recent tests by Consolidated Edison Company of New York show that purities better than 0.004 PPM total solids are achieved – purities "heretofore unknown." Heart of the Yuba evaporator is the patented improved bubble tray design. Yuba evaporators have reached their present peak because of continuous refinement of design, engineering and manufacturing. And Yuba's mechanical vapor purifier has also been found to be the most efficient of its type within the limits of mechanical purifier design.

Bubble tray or mechanical evaporators, Yuba designs are the most flexible in the industry. They can be installed vertically or horizontally—in a wide capacity range – depending on the industry need or basic plant design. Whatever your high purity water need, remember Yuba for the finest in evaporators. Write today for the complete story of tests on Yuba equipment – Bulletin YHT 101.

Other Yuba products for steam power plants include Condensers, Feedwater Heaters, Expansion Joints, Heaters, Tanks, Cranes, Structural Steel and scores of other items.

YUBA

specialists in power plant equipment

YUBA HEAT TRANSFER CORPORATION

Tulsa, Oklahoma
Plants in Tulsa and Honesdale, Pa.

YUBA CONSOLIDATED INDUSTRIES, INC.

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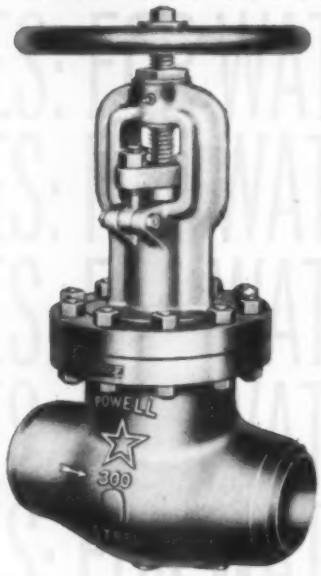
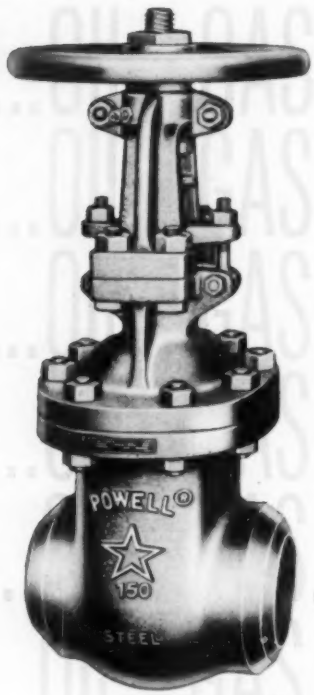
1500-pound Cast Steel Pressure Seal Horizontal Lift Check Valve—Fig. 11365WE. Also available for 600, 900, and 2500 pounds pressure.

900-pound Cast Steel Pressure Seal Non-return Globe Valve—Fig. 19084WE. Spur Gear operated. Can also be furnished for bevel gear operation.

300-pound Cast Steel Globe Valve—Fig. 3031WE. Bolted flanged yoke-bonnet, outside screw rising stem. Sizes 1" through 12".





150-pound Cast Steel Gate Valve—Fig. 1503WE. Bolted flanged yoke-bonnet, outside screw rising stem, interchangeable solid or double wedges. Sizes, ¾" through 30".

POWELL VALVES: FOR WATER...OIL...GAS.....

You can depend on Powell Valves to meet virtually every flow control requirement of today's power plants—whether conventional or nuclear fueled. Powell's nationwide stocking means even more . . . faster delivery, less down time and greater savings!

When you buy Powell Valves you buy dependable performance — the result of engineering skill and experience. For further information, call your Powell Valve Distributor or write us direct.

1500-pound Cast Steel Pressure Seal Gate Valve with by-pass Fig. 11313WE. Valves of this design can be supplied for 600, 900, and 2500 pounds pressure.

2500-pound Cast Steel Pressure Seal Gate Valve — Fig. 125023. Equipped with top mounted electric motor operator for remote control.

900-pound Cast Steel Pressure Seal Angle Valve—Fig. 19033WE. Valves for pressures from 600 through 2500 pounds can be furnished.

.....AIR...STEAM OR CORROSIVE FLUIDS

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115th year of manufacturing industrial valves for the free world

POWELL DEPENDABLE VALVES

THE WM. POWELL COMPANY, CINCINNATI 14, OHIO

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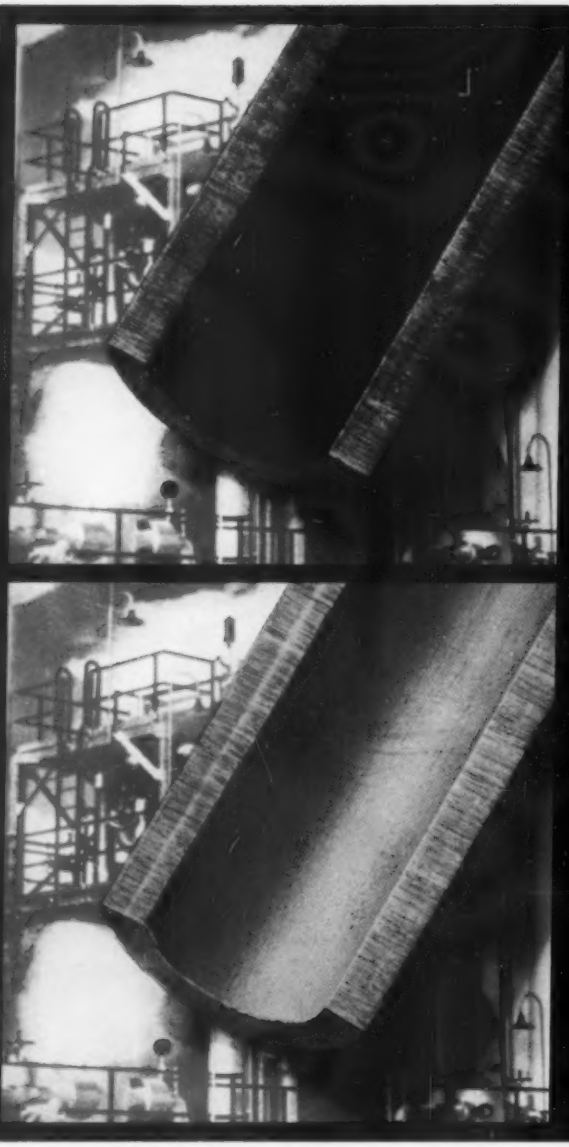
BETTER OPERATIONAL CLEANING BEGINS...

WITH THE NEW PFIZER CITRIC ACID PROCESS



These steel tube sections taken from a typical boiler system were "look-alikes" until one was cleaned with ammoniated Pfizer Citric Acid.

THE ADVANTAGES OF CITRIC ACID FOR PREOPERATIONAL CLEANING are widely recognized. Now, a new Pfizer process—using ammoniated citric acid—has opened the door to safer, more efficient removal of ***operational*** iron oxides and copper deposits from high-pressure steam generating surfaces. Field testing has proved the process to be both effective and practical.

Important to the success of the process is the fact that ammoniated citric acid solutions are good solvents for iron oxide deposits. And, because of the citrate's sequestering properties, the redeposition of dissolved iron is prevented. Then, too, the same solution, with additional ammonia and an oxidant, dissolves and removes copper deposits.

This one-solution cleaning process, discovered by S. Alfano of Houston Lighting and Power Company, permits substantial reduction of total cleaning time by eliminating intermediate draining and refilling steps. (Actual cleaning operations have been completed in 8-13 hours.)

The ammonium citrate process leaves metal surfaces in a passive state—tendency to rerust is minimized—no special after-treatments required. When stainless steels are present, chloride stress corrosion problems are eliminated. Important too, citric acid is dry, nontoxic, water soluble and easily handled.

For more data circle 517 on Post Card

Chas. Pfizer & Co., Inc.,
Chemical Sales Division,
New York 17, N. Y.

I want to learn more about the use of Pfizer Ammoniated Citric Acid for cleaning steel equipment. Please send me Data Sheet 561.

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Current Catalogs

New and revised publications reviewed on these pages offer help on operating and maintenance problems. To order, use the handy Reader Service Post Cards provided on pages 97 and 98.

Pumps, Compressors

101 Pump Selection Guide—"When You Buy A Pump," a 12-pp booklet by Sumo Pumps, Inc., aids in selecting pumps for water supply or booster service. Starting with factors to consider in choosing a pump, various types are discussed and a comparison checklist of desirable features provided.

102 Chemical Process Pumps — Information on bearing life expectancy, shaft deflection, interchangeability, performance, and application of chemical process pumps is presented in 16-pp Bulletin 725.1. Section drawings, construction details, composite curves included by Goulds Pumps, Inc.

103 Centrifugal Pumps — Detailed information on horizontally split-case centrifugal pumps is presented in 8-pp Bulletin 722.6 by Goulds Pumps, Inc. Includes performance curves, material specifications, interchangeability charts and dimensions.

104 Close-Coupled Pumps — Compact close-coupled, fhp, single stage-single suction pump for low-cost handling of clear non-corrosive liquids to 180 F is described in Bulletin 52B1010. Available from Allis-Chalmers Mfg. Co. in a range through 48 gpm with heads to 100 ft, pump can be installed horizontally or vertically.

105 Centrifugal Pumps — Features and advantages of single-stage, double suction horizontal split-case centrifugal pumps are detailed in 8-pp Bulletin 105C by Aurora Pump Div., The New York Air Brake Co. Includes sectional photos, and selection charts.

106 Vacuum, Pressure Air Pumps —Catalog 561, 32 pp, by Leiman Bros. Inc., gives data on pumps, motors, boosters and accessories, with details of construction, dimensions, capacities, performance curves and engineering and installation data. A handy cover index is keyed to numbered dividers for locating desired model quickly.

107 For Steady Pressure — Bulletin 08C9989, Allis-Chalmers Mfg. Co., describes the Accupressure system designed to maintain constant steady water pressure. Discusses components of the pumps used in the system, tells some of its many applications.

108 Pump, Compressor Selector— Set this slide rule (offered by Gast Mfg. Corp.) at required air flow in cfm and a choice of rotary air pump models is indicated. Setting pointer on opposite side of selector then gives motor horsepower requirements and air flow characteristics over 0 to 28 in. Hg vacuum or 0 to 30 psig pressure.

Mechanical Power Transmission

109 Adjustable-Speed Drives— Product description and application, factors in drive selection, and recommendations for special applications are covered in 32-pp Bulletin GEA-6999 by General Electric Co. Includes a price-comparison table, and describes operation principle, drive components, control functions, features and advantages, and functional requirements of the adjustable speed drive.

110 Speed Changer — Described in Bulletins 51B9061B and 51B1042 by Allis-Chalmers Mfg. Co. are speed changers designed to provide low cost variable speed, with mechanical, electrical and pneumatic control options. Covers five sizes providing stepless changes within standard ranges of 2 to 1 through 10 to 1 at operating speeds from 1.8 to 4660 rpm.

111 Replacing a V-S Belt—Twenty-pp Bulletin 24103 by T. B. Wood's Sons Co. contains an alphabetical listing of applications of all known manufacturers of equipment using variable-speed belts. Also lists parts numbers with corresponding Wood's numbers, and includes a numerical listing of V.S belts according to size.

Instruments and Controls

112 Industrial Instrumentation — Illustrated and described in 28-pp Bulletin G-61 by Industrial Instrument Corp. are differential pressure instruments, pressure and temperature recorders, indicators and transmitters, liquid level controllers and accessories for use in electronics, atomic energy, petrochemical, power plants, food processing, tank and transfer systems and other applications.

113 Process Instrumentation—Condensed Catalog 310, 8 pp, of Fischer & Porter Co., describes measurement instruments and complete systems for flow, level, pressure, temperature and other variables. Also covers company's capabilities in the field of instrumentation. Indicators, transmitters, recorders and controllers as well as sensing elements are listed.

114 Multi-Point Gages — Described in Bulletin 322.11 by Republic Flow Meters Co. are multi-point gages for indicating draft, pressure, differential and temperature. Mounting dimensions and installation data included.

115 Petroleum, Industrial Meters— Thirty-pp Catalog P&I-2000, by Rockwell Mfg. Co., describes meters, packaged units for volatile liquids, and the Rockwell Turbo-Meter. Cutaway drawings show construction features and dimensions. Also described are electrical impulse contactors, a key control panel, air eliminators, line strainers, registers, temperature compensators.

116 Turbine Flowmeters—Featured in 12-pp Bulletin 1384C by Cox Instruments Div., George L. Nankervis Co., are turbine flowmeters for flow rate and total flow, and automatic process control in batching and blending systems. Technical information includes ranges, accuracies, frequeny outputs.

117 Transmitter Data—Bailey Meter Co. offers three specification sheets on transmitters and mechanisms. Bulletin G21-4, describes Mini-Line units for transmitting differential pressure measurements to indicating, recording and/or controlling equipment at remote locations. Bulletins P21-4 and E21-4 cover pneumatic pressure transmitting mechanisms and electrical pressure trasmitting mechanisms, giving standard ranges, operating characteristics.

118 On Pressure Transducers—Bulletin P-61206 and 8-pp Service Manual offered by Taber Instrument Corp. contain information on a strain gage pressure transducer for electrical measurement of fluid and gas pressures. Manual contains instructions for calibration and maintenace.

119 Selection of Recorders — Complete specifications for the selection of direct- and servo-operated, switchboard and portable recorders are presented by General Electric Co. in 12-pp Bulletin GEA-6933A. Lists over 40 electrical and physical parameters that can be measured in utility, industrial use.

120 Liquid Level Alarms—Bulletin EX-700 by King Engineering Corp. contains information on liquid level alarms that turn on a built-in signal light and sound an alarm when liquid reaches a predetermined level.

121 Thermocouple Assemblies—Detailed specifications and price lists for general purpose and special-use thermocouple assemblies and components are included in 40-pp Catalog G100-1 by Minneapolis-Honeywell Regulator Co. Complete selection and application information given.

122 Feedpump Recirculation — Advantages of feedpump recirculation control from temperature difference and the two basic systems evolved—on-off and proportional control—are described in Bulletin MSA-196, 8 pp, by Hagan Chemicals & Controls, Inc. Diagrams show functionings of the two systems, and equipment for use with each is listed.

Current Catalogs

123 Leak Detectors—Portable, halogen sensitive, electronic leak detectors for protection against leaks in pressure or vacuum systems are featured by General Electric Co. in 8-pp Bulletin GEA-6817A. Tells how to select proper percent of tracer gas and test pressure.

124 Residual Chlorine Analyzer—Featured in 6-pp Catalog 17B2200, by Fischer & Porter Co., is a continuous amperometric analyzer for water supplies and sewage effluents. Dimension drawings, typical chlorination system, data and specifications included.

Valves

125 Control Valves — Features of sliding gate diaphragm control valves are illustrated with cutaway diagrams in 8-pp Catalog DCV-1 by OPW-Jordan Corp. Includes pressure and temperature ratings, capacity charts, dimensions, flow chart, diagrams of hook-ups, and sample specifications.

126 Gate Valve—Described in Circular 561 by Lunkenheimer Co. are clip-type gate valves designed to withstand corrosive actions too severe for lighter valves. Two types are featured —iron-body, bronze-mounted for general corrosive service; and all-iron for solutions which attack bronze.

127 Improved Ball Valves — This brochure of Worcester Valve Co., Inc., enables easy selection of proper size and materials of Econ-O-Miser ball valves. Illustrates features, types of pipe ends which can be used with the valves. Includes cost comparison between standard ball valve, standard gate valve and Econ-O-Miser.

128 Spherical Plug Valve — Performance details and advantages of the spherical plug valve—a non-lubricated low torque valve—are described in a product bulletin by Pittsburgh Brass Mfg. Co. Dimension table and ordering information included.

Heating, Ventilating and Air Conditioning

129 Heat Transfer Coils—Technical Data Bulletin 356 by Dean Products, Inc. contains 26 pp of information on panel type heat transfer coils. Provides an instantaneous LMTD chart, typical load computations, heat transfer factors, selection of heating surface and other selection details. Diagrams show dimensions and surface areas.

130 Water Heating Equipment—Featured in 16-pp Form 1551B by Dunham-Bush, Inc. are expansion tank, steam and water converters with typical installation diagram. Includes specifications, pressure drop tables and complete data, including circulators, valves, fittings, specialties, converters.

131 Maximum-Duty Fans — Bulletin A-1401, 48 pp, by American-Standard, discusses construction and operation of Sirocco fans, with drive arrangements, control methods and types of drives illustrated. Capacity tables and outline drawings keyed to tabular data for dimensions for use in working layouts are also included.

132 Air Conditioning Equipment—The 40-pp 1961-62 Estimating Catalog presented by Blazer Corp. is a comprehensive price and selection guide to air conditioning, ventilation, refrigeration and heating equipment.

Lubrication

133 Lubricating, Electrical Devices —Illustrated and described in 12-pp Condensed Catalog 61 by Trico Fuse Mfg. Co. are automatic oilers, chain oilers, mist systems, industrial fuses, and fuse accessories. Capacity and dimensional data included.

134 Bottle Oilers—Illustrated Circular 580, by Lunkenheimer Co., describes bottle oilers for plain bearing lubrication, providing dimensions, oil capacities, installation techniques, application methods.

Safety

136 Fire Safety Equipment—Portable fire extinguishers, smoke and fire detectors, and built-in carbon dioxide systems are featured in 12-pp Brochure P-67 by Walter Kidde & Co., Inc. Includes chart outlining types of extinguishers suitable for use on ordinary combustible, flammable liquid, and electrical fires.

137 Accident Prevention Signs—Warning signs for practically every type of industrial danger and caution condition are illustrated in color and described in 64-pp Catalog 11 by Stonehouse Signs, Inc. Tables of prices and specifications are given.

Water Management

138 Boiler Feedwater Treatment—Essentials of boiler feedwater treatment are discussed in 24-pp Bulletin 30 by Nalco Chemical Co. Explains why water treatment is needed, and describes such treatment methods as coagulation and precipitation, ion exchange process.

139 Automatic Gravity Filter—Bulletin WC-130, 6 pp, by Graver Water Conditioning Co., contains flow diagrams and dimensions of Monovalve, a gravity filter with a single control valve, describing its construction, operation and applications.

140 Water Treatment Exchanger—This 12-pp guide to Ionac C-240, sulfonated polystyrene cation exchanger for water treatment, by Ionac Chemical Corp., sets forth in text, charts and tables, their chemical properties, operating characteristics. Also gives operational information on sodium and hydrogen cycles

141 Process Equipment—Illustrated and described in Bulletin GEN 61 by Industrial Filter & Pump Mfg. Co. are pressure filters, ion exchangers, demineralizers, water softeners, centrifugal pumps, heat exchangers, and waste treatment systems.

142 Intake Water Strainer—Construction and design details of rotary water strainers designed to keep debris and solids from water taken in from seas, rivers and canals for use by industry and utilities are given in this 10-pp bulletin by Richardsons Westgarth Ltd. Sectional arrangement diagrams and data included.

Materials Handling

143 Conveyor Belt Engineering—Information required for horsepower calculation is included in 28-pp Bulletin 175 by Hewitt-Robins. Data on speed and idler factors and how to determine them, horsepower required to overcome pulley friction, estimated average belt weights, determining horse-power for acceleration, maximum allowable working tension for various types of belting, takeup etc.

144 Conveyor Belt Maintenance—This handy wall chart, by Hewitt-Robins shows how to reduce wear and tear on conveyor belting through proper maintenance. Covers storage, records, alignment, impact idlers, drive pulley lag, inspection schedules, lubrication, fasteners, repair etc. Gives tips on proper belt for specific applications.

Electrical

145 Pump Motors — Horizontal and vertical a-c pump motors in open jet-pump and close-coupled designs, single phase capacitor and three-phase squirrel cage types are featured in 6-pp Bulletin L-4121A by Kingston-Conley, Inc. Specification tables included.

146 Network Transformers—Compact and lightweight network transformers designed for rugged, continuous low-cost service are illustrated and described in 8-pp Bulletin CS-601 by Kuhlman Electric Co. Includes tables of ratings and tap arrangements, dimensional data and diagrams.

147 Sealed Dry-Type Transformers —Eight-pp Bulletin GEA-6790A describes General Electric Co's gas-filled sealed dry-type transformers offering higher impulse levels, lighter weight. Includes tables of dielectric tests, standard ratings, dimensions, weights.

148 Distribution Transformers—Described in 16-pp Bulletin GEA-7524 by General Electric Co. are distribution transformers designed for lower installation, maintenance and change-out costs as well as lower purchase and "built-in" costs. Selection tables and other data included.

149 Stationary Housed Equipment —Bulletin GEA-7186, by General Electric Co., discusses low cost switch and

site for a town that drinks nothing but SEA

Sun-baked desert, parched and waterless — not a very promising site for a town. But, with the development of the Richardsons Westgarth multi-stage vacuum flash sea-water evaporator, it is now economically feasible for towns in arid coastal countries to draw all their fresh water from the sea.

These evaporators were pioneered in Great Britain by Richardsons Westgarth. The largest of them could distill 2,000,000 gallons of sea-water a day — enough for a town of 250,000 inhabitants — and the distillate is purer than many mains water supplies from conventional sources.

Richardsons Westgarth evaporators are at work in South America, the Middle East and elsewhere, providing fresh water for both domestic and industrial applications.

These units are at their most economical when used in conjunction with low-pressure steam or back-pressure turbines and, as manufacturers of most of the major equipment for power generation, Richardsons Westgarth are particularly well qualified to carry out completely integrated schemes.

R W G

RICHARDSONS, WESTGARTH & CO. LTD.

The Controlling Company of the Richardsons Westgarth Group,
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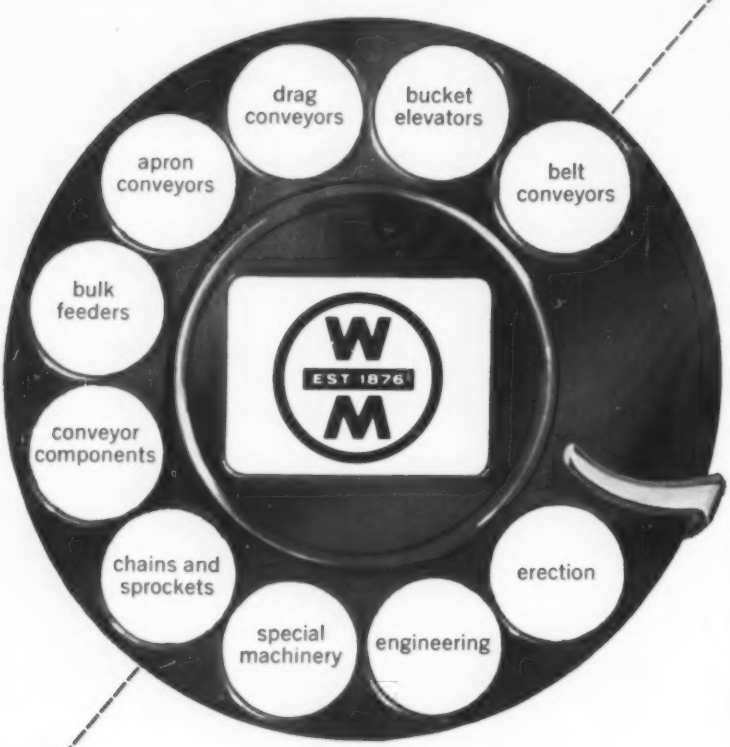

●Materials handling averages 30% of total U.S. production costs. *How much for your own business?*

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fuse equipment rated 2.4 to 15 kv. Details on auto-blast interrupter switch included. Gives details on one-half cycle fault clearance and equipment's construction, design and application.

150 Semiconductor Power Rectifiers—The 56-pp revised "Guide to Metallic Power Rectifiers" of The Meaker Co. features power supplies utilizing silicon and selenium semiconductors for a-c to d-c applications. Includes anodizing, battery charging, current limiting, electrochemical processing, electron tube testing, relay testing, shop power supplies, and semiconductor power conversion systems for operation of electrolytic cells.

151 High Dielectric Sealer—Technical Bulletin EL-65A by Johns-Manville describes a heavy duty electrical insulation material with high dielectric strength. Application method is illustrated, table of properties included.

152 Post Insulators — Construction and features of General Electric Co.'s stacking station post insulators rated 550 to 1470 kv are detailed in Bulletin TIA-184. Includes details on the metal-polymer seal, table of characteristics.

153 Electrical Products — Metallic, helically-formed products are featured by The Fanner Mfg. Co. in series of data sheets compiled in Data EP-825. They include armor rods and lineguards for protecting conductor spans at supports, dead-ending grips for strands or conductors, lashing rods for holding conductors to messenger strands, splices, as well as treeguards, moldings for conductors and cables, tubings, molding straps.

Automation

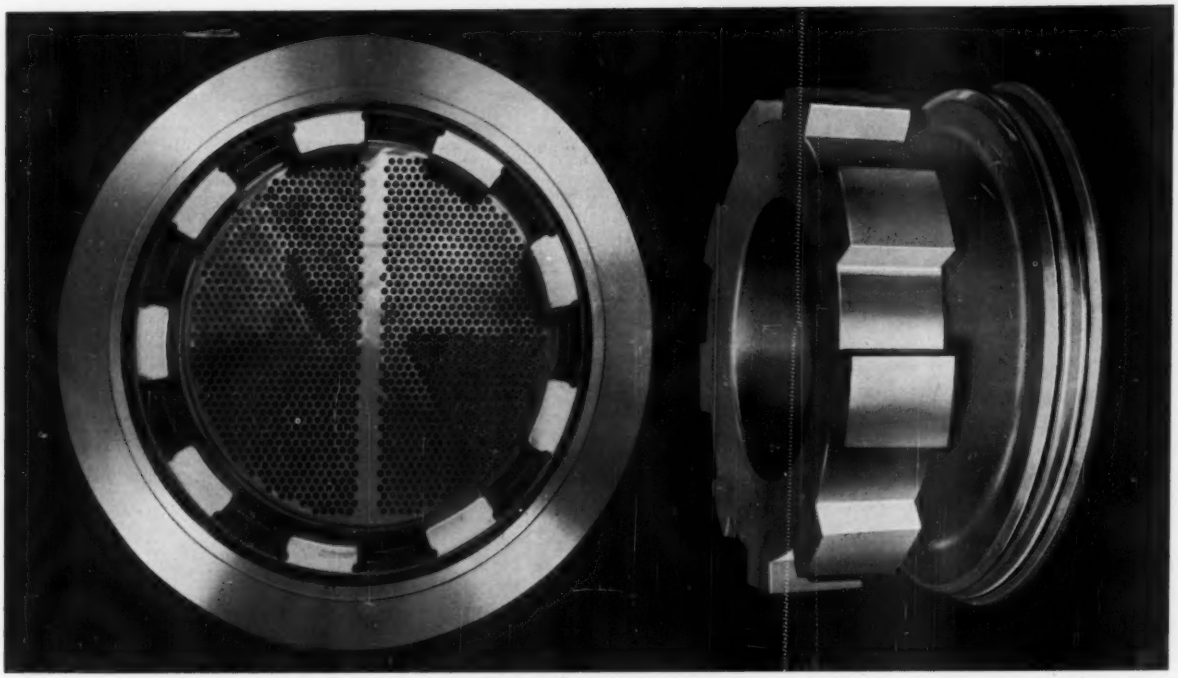
154 Digital Data System—Modular digital data systems for alarm scanning and digital recordings of virtually any type or combination of analog values are described in 8-pp Systems Brochure 7000 by Monitor Systems, Inc. Discusses system design features, applications, and illustrates building blocks and sub-assemblies available.

155 Compact Analogger — Design data and operating benefits of an easily-installed analogger are discussed in 8-pp Bulletin 201.11 by Republic Flow Meters Co. Provides information on optional recording receivers and integrators used with analogger.

156 High-Speed Computer — The "400" a low-cost medium-sized data processing system for streamlined control of record-keeping and reduced costs of handling paperwork is featured in a 10-pp brochure of Minneapolis-Honeywell Regulator Co. Automatic programming aids and specifications of components are listed.

Other Equipment

157 Air Control Products—Air and hydraulic equipment for automating in-plant operations, including cylinders, valves, rotating joints, filters, regula-



Simplicity and Easy Maintenance

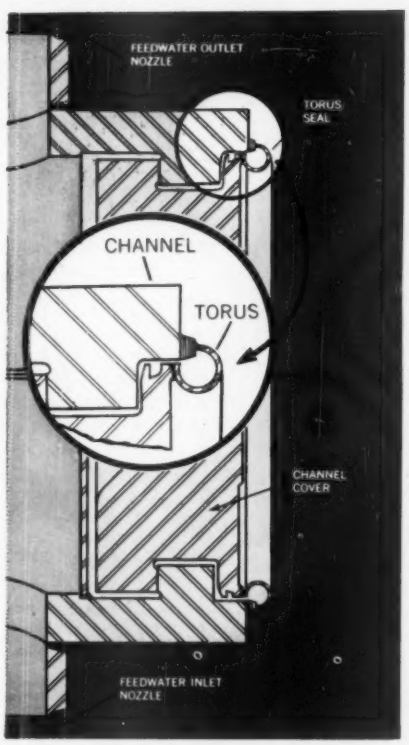
win quick acceptance for new FW Feedwater Heater Closure

Utilities had their first look at this gasketless Breech-Lockhead for feedwater heaters last year. Decisions to buy followed quickly among leading utilities including Pacific Gas and Electric, Omaha Public Power District, Toledo Edison Company, and Gulf States Utilities. Over 30 large high-pressure units have also been ordered for foreign utilities.

Why such fast acceptance by an industry which weighs every advance with extreme care? Because the FW Breech-Lockhead closure combines two proven principles—the torus and the breech-lock—the best way yet devised for achieving simplicity and ease of maintenance with a positive seal. The torus, welded to the edges of the channel and cover, provides a fully *leakproof seal independent of hydrostatic pressure.*

Disassembly and reassembly is quick and easy. When the torus is cut away from the channel, it remains attached to the pressure cover which may then be quickly removed. Simple tools make cutting, removal, replacement and rewelding a routine procedure.

If you are now considering feedwater heaters, get full information on this new FW Breech-Lockhead. It will simplify your maintenance. Foster Wheeler Corporation, 666 Fifth Avenue, New York 19, N. Y.



FOSTER WHEELER

NEW YORK TORONTO LONDON PARIS MILAN TOKYO

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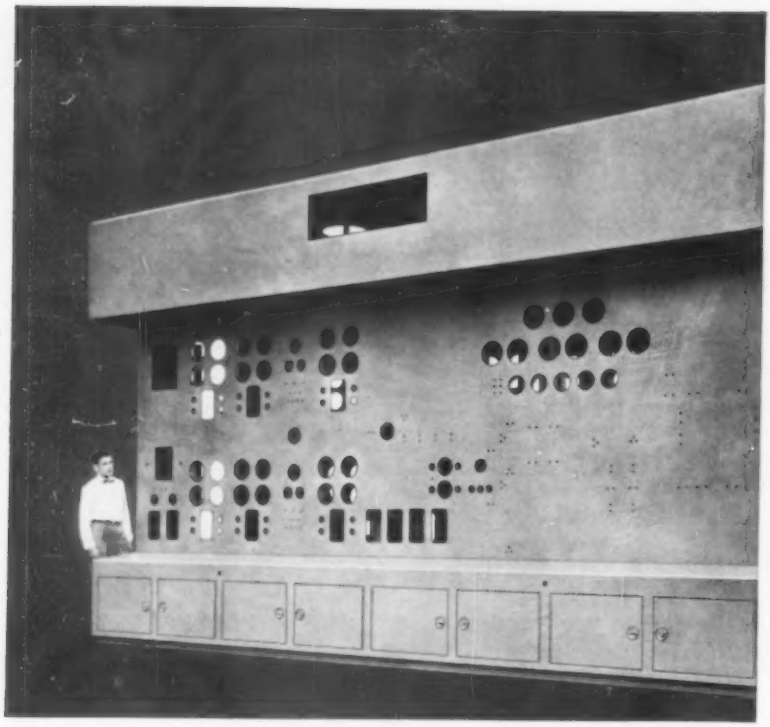

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tors, couplers and hose fittings is featured in 48-pp Catalog 125 by A. Schrader's Son, Div. Scovill Mfg. Co., Inc. Includes dimensions, flow rates, operating pressures, and typical air control circuits.

158 Diesel Engine—In 8-pp Bulletin 5000-A, Fairbanks-Morse & Co. presents design and performance advantages of the Model 50A series of diesels covering a range from 37 to 690 hp at 1800 rpm. These are four-cycle, naturally aspirated and turbo-supercharged "working engines" for power units, generating sets etc.

159 Concrete Admixture — Pozzolith's role as a concrete admixture providing durability, strength and economy in the construction of dams is covered in 48-pp Bulletin MBR-P-3 by The Master Builders Co. Features case histories on major dams built in United States and the world.

160 Jacketed Insulation—Described in 8-pp Bulletin IN-217A by Johns-Manville is an integrated pipe insulation that combines metal jacketing, high temperature calcium silicate insulation, and a moisture barrier in one plant-fabricated unit. Installation details included.

161 Helicopter Service—This 16-pp brochure describes Hiller Aircraft Corp.'s three- and four-place helicopters for use in pre-bid inspection, aerial surveys, construction of powerlines, dams, transmission towers, and other power projects. Case histories are cited, performance charts included.

162 Closed-Circuit TV — Specification data and design details on an all-weather closed circuit television system with weatherproof cabinet are given in Specification Data Form 2604 by Diamond Electronics.

163 For Controlled Feeding—Bulletin 4.20-1, 8 pp, by B-I-F Industries, covers feeding, weighing, blending and proportioning equipment for controlled feeding of liquids and solids. Contains photo, schematics of typical process systems, and a listing of systems within broad application range of the conrtolled feeding equipment.

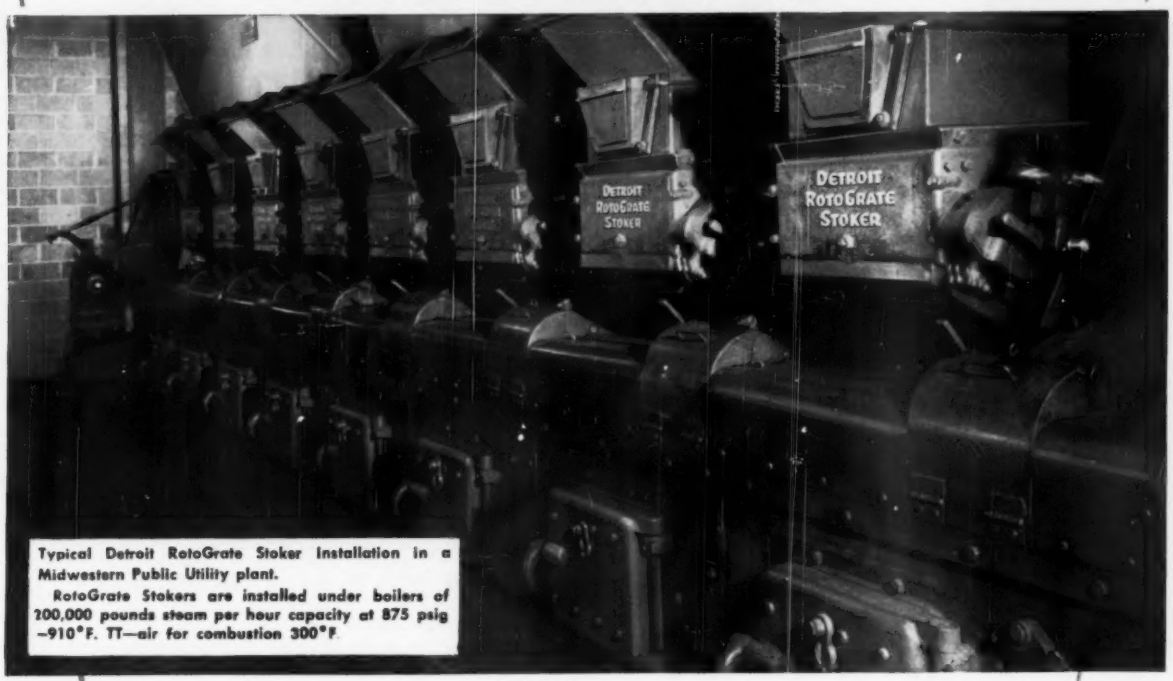
164 Power Plant Equipment — Steam and electrical equipment for power plant and industry is illustrated and described in 16-pp Bulletin Q-24A by Elliott Co. Covers steam turbines, motors, generators, ejectors, compressors, turbochargers, strainers and tube cleaners.

165 Compact Exchangers — Basco, Inc., provides information on their stock model compact heat exchangers in Bulletin F-1161. Standard sizes, dimensions, and weights are listed for one-, two- and four-pass exchangers.

166 Stainless Condenser Tubes — Applications of stainless steel condenser tubing are described in this 10-pp bulletin by Allegheny Ludlum Steel Corp. Performance curves are included, as well as information on maintenance, fabrication and vibration.

WHAT OUR CUSTOMERS *"Say"* ABOUT

Detroit ROTOGRATE STOKER Performance



Typical Detroit RotoGrate Stoker installation in a Midwestern Public Utility plant.

RotoGrate Stokers are installed under boilers of 200,000 pounds steam per hour capacity at 875 psig –910°F. TT—air for combustion 300°F.

Our field engineers get around—visit plants in all parts of the country and their reports tell us that users say their RotoGrate Stokers—

DO OPERATE with lower excess air—22% is common—less in many cases . . . Reason—the floating, self-adjusting air seals—a RotoGrate exclusive.

DO HANDLE load fluctuations easily . . . Sudden load increases picked up without loss of pressure—the thin fast burning fuel bed permits dropping load surges just as rapidly.

DO BURN all grades of bituminous and lignite coals, and, many kinds of waste and refuse fuels . . . Ability to burn the less costly fuels available in any area is a potent factor in economical operation.

DO MAINTAIN uniform high efficiency in everyday operation. RotoGrate doesn't need special test conditions to show superior results.

DO SET a high standard of availability . . . A survey of users shows exceptional availability records in all kinds of plants.

DO OUTPERFORM other fuel burning equipment . . . Where it is possible to compare with other fuel burning equipment under similar conditions, operators almost without exception express preference for the RotoGrate.

DO SAVE . . . Low cost fuels—high efficiency—very little parasite power for operation—broad load ranges with uniform steam pressure—low maintenance—and not least important reduced production losses from outage . . . all contribute to savings that pay a handsome return on the investment.

DO YOU feel you can afford not to avail yourself of these advantages and economies for YOUR boiler plant? Why not write for bulletin 40 which describes the RotoGrate for boilers up to 400,000 pounds per hour capacity? Then let us recommend the correct stoker for your needs, without obligation of course.

Write **DETROIT STOKER COMPANY**

DIVISION OF UNITED INDUSTRIAL CORPORATION

MAIN OFFICE AND WORKS MONROE, MICHIGAN

District Offices or Representatives in Principal Cities

For more data circle 522 on Post Card

HELPFUL WATER CONDITIONING DATA FROM BETZ

EXCESSIVE BOILER BLOWDOWN

■ Close control of blowdown is essential, not only to avoid operating difficulties but also to achieve operating economy.

WITH THE GENERATION of pure steam, all the solids—dissolved and suspended, that enter the boiler with the feedwater remain in the drums and tubes. Continued addition of feedwater results in greater and greater accumulation of solids until some limit is reached beyond which operating difficulties will develop. The limit may be the amount of sludge, the dissolved solids or some component of the dissolved solids—such as the alkalinity or silica concentration. Every individual boiler has some limiting factor which if exceeded will eventually produce operating difficulties. In addition to the chemical factors, there are many mechanical factors that influence the boiler water concentrations which can be maintained safely in a particular unit. These include boiler design, pressure, rating, water level and load characteristics.

The purpose of boiler water blowdown is to control concentrations—both dissolved and suspended—within safe limits so as to assure trouble-free operation. The objective is accomplished by ejecting some of the concentrated water from the boiler and replacing it with feedwater. The rate of boiler blowdown is defined as the ratio of the quantity of blowdown water to the quantity of feedwater and is expressed usually in percentage as follows:

$$\frac{\text{Quantity of Blowdown Water}}{\text{Quantity of Feedwater}} (100) = \% \text{ Blowdown}$$

Chemical Factors

Excessive amounts of total solids—both dissolved and suspended—can promote carryover of boiler water with the steam. When boiler water solids are carried over in the steam, deposits will occur in non-return valves and stop valves, superheaters, steam piping and engines or turbines. Serious loss to turbine efficiency may result or incrustations on governor valves may cause over-speeding or wrecking of the machine. It is essential that safe boiler water operating limits be established to avoid carryover.

Operating Pressure, psig	Total Solids ppm	Total Alkalinity ppm	Suspended Solids ppm
0- 300	3500	700	300
301- 450	3000	600	250
451- 600	2500	500	150
601- 750	2000	400	100
751- 900	1500	300	60
901-1000	1250	250	40
1001-1500	1000	200	20
1501-2000	750	150	10
2001 and higher	500	100	5

Figure 1

The American Boiler Manufacturers' Association stipulates in its standard guarantees on steam purity boiler water concentrations shown above.

It should be noted that limits for total solids, alkalinity and suspended solids are stipulated. The effect of dissolved solids, suspended solids and alkalinity on carryover has been a subject of considerable research. In some plants alkalinity is the determining factor, while in other plants it is the total dissolved solids which limit the boiler water concentration that can be maintained without carryover. In general, it is agreed that part for part suspended solids have a more pronounced effect on promoting carryover.

Suspended solids include precipitates which are formed within the boiler as a result of the precipitation of hardness as well as any suspended matter which enters the boiler with the feedwater. Internal boiler water treatment with phosphate control is standard for most types of feedwater, and is designed to precipitate the calcium hardness as calcium phosphate. There is a tendency for finely divided precipitates, such as calcium phosphate, to promote boiler water foam and thus contribute to carryover of boiler water with the steam. In addition, excessive amounts of suspended solids will cause sludge accumulation or scale formation. The heat insulating effect of deposits on heat transfer surfaces can result in the loss of boiler efficiency. Even more important is the possible overheating of the boiler tubes and the consequent tube failures that can result. It is therefore essential that blowdown limits be properly established to avoid the adverse effects of excessive amounts of suspended solids.

High boiler water alkalinity tends to promote foam formation and may also contribute to caustic metal embrittlement. In boilers operating at very high pressures, excessive caustic alkalinity can contribute to caustic corrosion.

One other very important factor that must be taken into consideration is boiler water silica concentrations. Very high boiler water silica concentrations are undesirable due to the danger of silica deposition, or the formation of very hard complex types of silica scales such as analcite and acmite. In addition, in boilers operating above 400 psi gage, high silica concentrations can result in silica vaporization and the formation of siliceous deposits on turbine blading. Suggested permissible limits for boiler

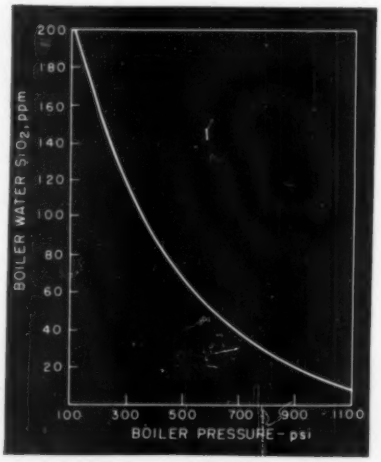


Figure 2

water silica concentrations are shown in Figure 2.

Mechanical Factors

Boiler design has a marked influence on the safe limits that can be maintained both from the standpoint of carryover and deposit formation. It is obvious that in some of the older boiler designs, where all steam carrying tubes discharge below the water level, a great deal more turbulence results in the boiler drum compared to the more modern designs where steam carrying tubes enter the drum above the water level or through separating devices.

Boiler design must also take into account the effect of operating pressure. At high boiler pressures, the difference in water-steam density decreases and the effect of gravity on water and steam separation is decreased.

High water level is one of the most frequently encountered causes of carryover as well as one of the easiest to correct. The method of firing a boiler may be such as to disturb circulation and contribute to carryover.

Obviously, operating a boiler at loads in excess of designed rating will provide more cause for carryover than operating within the designed rating. Sudden load changes will cause more difficulty than steady loads.

Each of these factors has a bearing on establishing safe limits for an individual boiler to avoid carryover. Boiler circulation, type firing and particularly 'hot spots' in the boiler have a substantial effect on sludge accumulation and scale formation.

Blowdown Economy

High blowdown rates are wasteful. In addition to the heat loss, an increase in make-up water is required. If the make-up water is treated the added cost of external treatment is a factor, as well as the added cost for internal treatment. Therefore it is desirable to establish a blowdown rate that is adequate to assure trouble-free operation of the boiler, and yet is not excessive so that costs are held to a minimum.

The ABMA limits should be viewed only as a guide in establishing safe operating limits for any individual boiler. The many variables that affect the establishment of safe limits must be taken into consideration. In some cases, because of boiler design or high silica values, it may be necessary to establish limits well below ABMA stipulations. In these cases improved external treatment methods may be helpful. Conversely, in many cases it is possible to establish limits well above ABMA stipulations and thereby secure greater economy. The antifoam agents that have been developed in recent years, when properly applied, frequently will permit establishing limits considerably above ABMA stipulations and still permit generating steam of excellent purity. The advances made through research in the development of sludge conditioning agents frequently permit higher suspended solids than ABMA stipulations. A thorough investigation of all factors involved will determine whether or not some improvement in the external or internal feed-water conditioning program will permit blowdown savings which will more than off-set the cost of the improved method of treatment. Figure 3 illustrates the savings in fuel alone which can be accomplished by a reduction in blowdown rate from 6% to 2%.

Evaporation	= 2,000,000 lbs. steam
Boiler Pressure	= 200 psi gage
Feedwater Temperature	= 215 F
Make-up Water Temperature	= 60 F
Present Blowdown Rate	= 6%
Reduced Blowdown Rate	= 2%
Boiler Efficiency	= 80%
Fuel = Oil at 150,000 Btu/gal., 7.0c/gal. delivered and fired	
Feedwater	= Steam plus blowdown
Feedwater at 6.0% Blowdown	= 2,128,000 lbs.
Feedwater at 2.0% Blowdown	= 2,041,000 lbs.
Saving in Feedwater	= 87,000 lbs.
Heat of Liquid at Boiler Pressure	= 362 Btu/lb.
Heat of Liquid at 60 F	= 28 Btu/lb.
Heat Saving	= 334 Btu/lb.
Total Heat Saving = 87,000 lbs. x 334 Btu/lb.	= 29,058,000 Btu
At Boiler Efficiency of 80% There is Actually Utilized 150,000 Btu/gal. x 0.80	= 120,000 Btu/gal.

$$\text{FUEL SAVINGS} = \frac{29{,}058{,}000 \text{ Btu}}{120{,}000 \text{ Btu/gal.}} = 242 \text{ gal.}$$

DAILY SAVINGS = 242 gal. oil x $0.07/gal. = $16.94

Figure 3—Typical Calculations on Savings Possible Through Reduction in Blowdown Basis—1 Day

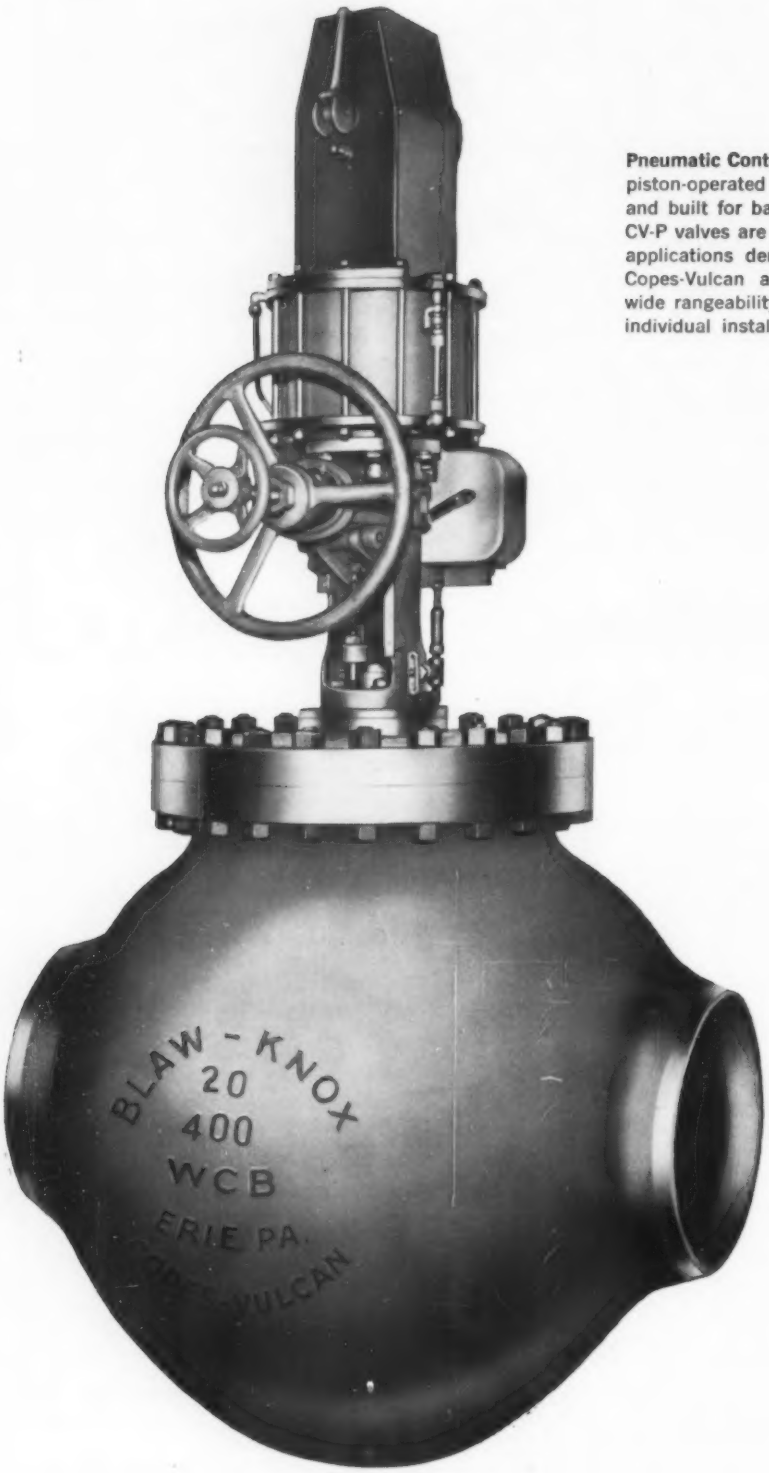
In every plant the subject of blowdown is sufficiently important to justify a study of all the factors involved. Betz has the products and ability to handle all phases of your boiler water conditioning problems effectively and economically. A Betz Engineer will be pleased to discuss your water conditioning problem. Why not contact him today.

CAN BE COSTLY

BETZ LABORATORIES, INC.

PHILADELPHIA 24, PENNSYLVANIA

■ CONSULTANTS ON INDUSTRIAL WATER PROBLEMS



Pneumatic Control Valves—This 20-inch, 400-psig pneumatic piston-operated double-seated control valve was designed and built for back-pressure service in a utility station. Type CV-P valves are recommended for flow- and pressure-control applications demanding the finest valves money can buy. Copes-Vulcan also offers diaphragm-operated valves with wide rangeability and control characteristics tailored for the individual installation.

COPES-VULCAN

Hydraulic Control Valves—This 600-psig hydraulically-operated control valve, with 16-inch inlet, 20-inch outlet and 2½-inch stroke was designed and built for steam-dump in 80 milliseconds and precise back-pressure control. Copes-Vulcan offers valves in sizes up to 20-inch, and in pressure standards up to 2500-psig. They may be single- or double-seated. They can handle pressure drops up to 2000 psig.

Nuclear Valves—This 6-inch, 1500-psig motor-operated three-way selector valve for use in a stationary nuclear power plant was built of stainless steel for primary-fluid relief service. The unique design reflects the engineering capability offered by Copes-Vulcan for the solution of the most difficult problems encountered in both nuclear and conventional power stations.

for today's needs...for tomorrow's planning

Copes-Vulcan offers equipment and control systems for boiler cleaning, combustion, feedwater, desuperheating, pressure reducing, and superheat and reheat steam temperatures. Each is available separately, or as an integral part of a single control package, custom-engineered to meet individual needs.

Copes-Vulcan also offers special valves for applications in conventional and nuclear power plants on land and sea. Like all Copes-Vulcan products, they are backed by experience gained in serving the power industry for more than half a century. Copes-Vulcan Division, Erie 4, Pennsylvania.

Copes-Vulcan Division

BLAW-KNOX

BLAW·KNOX

Blaw-Knox designs and manufactures for America's growth industries: METALS: Rolling Mills • Steel Processing Lines • Rolls • Castings • Open Hearth Specialties • PROCESSING: Process Design, Engineering and Plant Construction Services • Process Equipment and Pressure Piping • CONSTRUCTION: Concrete and Bituminous Paving Machines • Concrete Batching Plants and Forms • Gratings • AEROSPACE: Fixed and Steerable Antennas • Radio Telescopes • Towers and Special Structures • POWER: Power Plant Specialties and Valves

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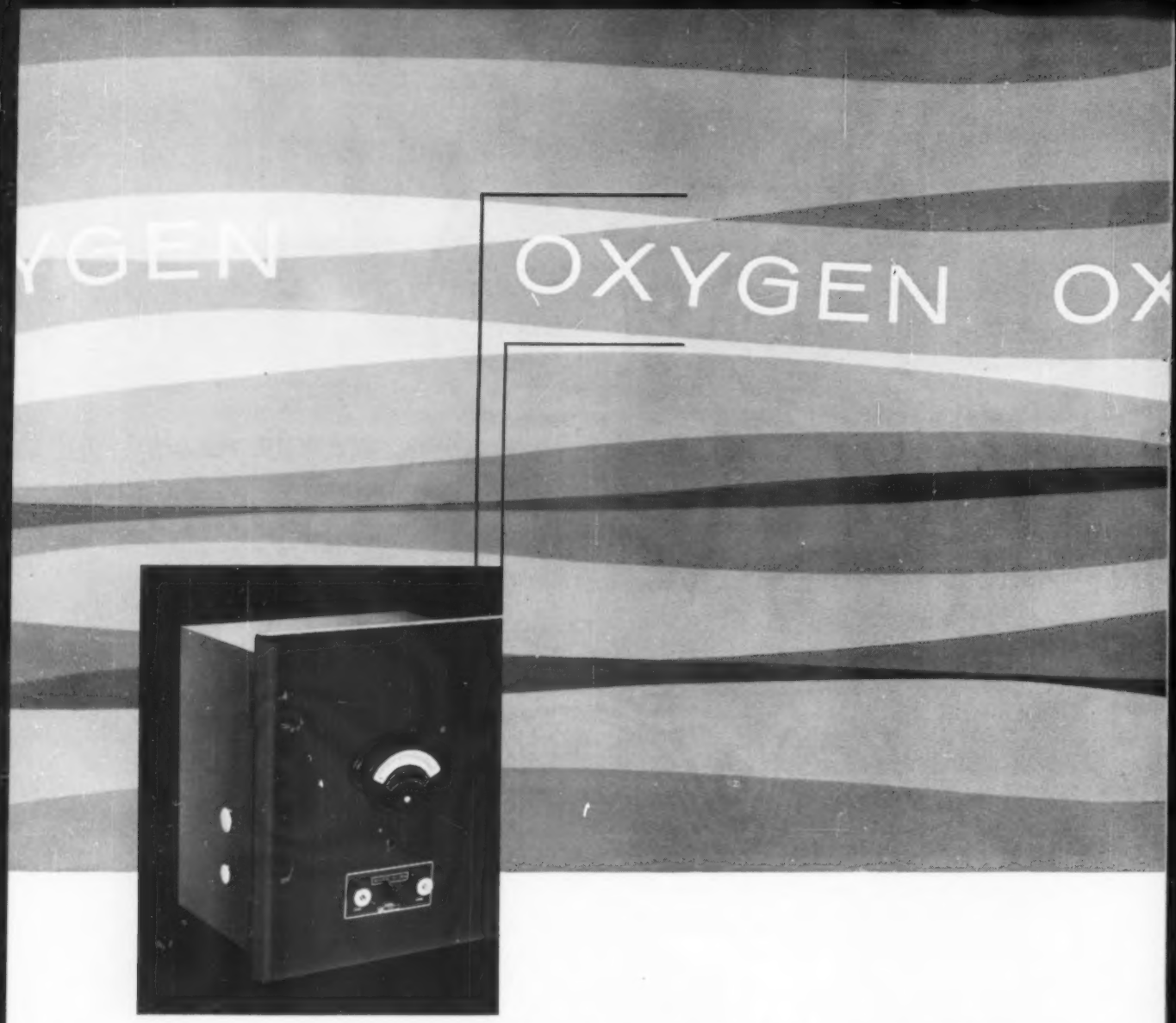

Wherever continuous oxygen measurement must be accurate...Beckman has the right answer!

Beckman has the instrument that's made to order for your oxygen measurement application. For Beckman has the most complete line of Oxygen Analyzers from which to choose. Measure 0_2 in ranges from parts per million to 100%—with sample handling equipment to meet your most exacting requirements.

Your Beckman Sales Engineer has the answers to your questions on process Oxygen Analyzers. Contact him for complete details, or write for Data File 78-11-08

MODEL F-3 operates on a paramagnetic principle found only in Beckman® Oxygen Analyzers. Assures fast response, great sensitivity, and simple operation. And the F-3 has dual ranges that are directly linear. Read oxygen concentration from a self-contained meter or a standard potentiometric recorder. The Model F-3 is ideal for wide ranges of analyses—from 0-1% to 0-100%—and suppressed ranges are available, too.

MODEL G-2 also utilizes the paramagnetic principle of operation. Supplied with potentiometric recorder modified to provide automatic instrument zeroing for critical analyses. The Model G-2 is ideal for narrow and highly suppressed ranges—0-1000 ppm to 99-100%.

MODEL 80 TRACE OXYGEN ANALYZER operates on the electrolytic cell principle. This dual range instrument provides highly accurate linear measurement in the parts per million ranges. The Model 80 is particularly suited for monitoring gases in which oxygen content must be extremely low—from 0-5 to 0-500 ppm.

ALSO AVAILABLE AND READY TO SERVE . . . a complete line of portable laboratory oxygen analyzers.

Beckman INSTRUMENTS, INC.

SCIENTIFIC AND PROCESS INSTRUMENTS DIVISION

Fullerton, California

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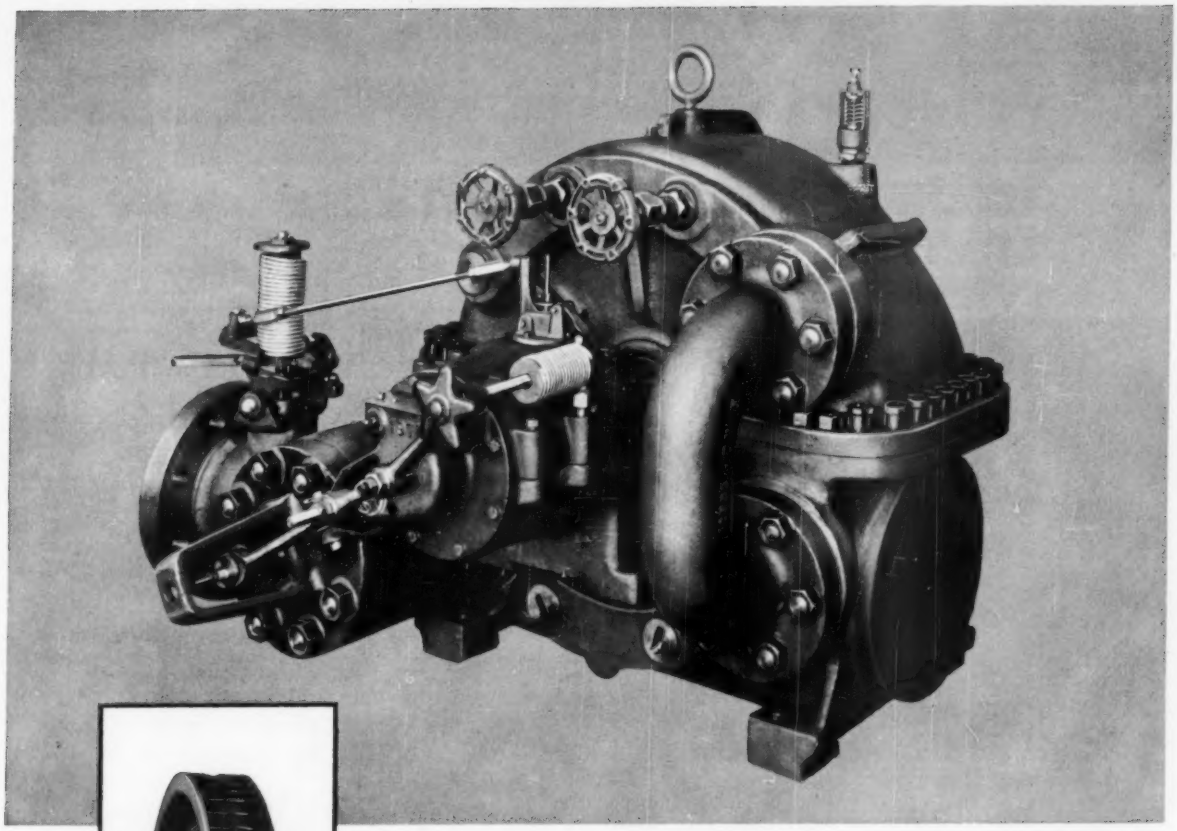
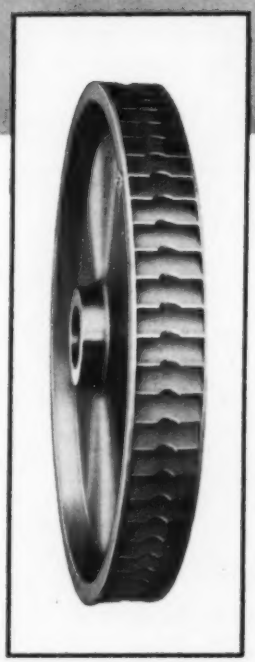




solid-wheel turbine means performance instead of worry

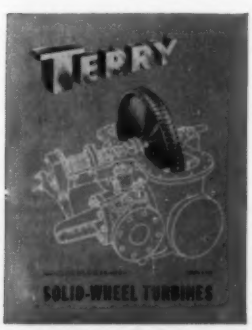
In these days of automated production, proven reliability has come to be highly prized in a machine. That fact helps to explain the popularity of the Terry solid wheel. For here is a turbine designed from the start to be solid and simple . . . require minimum maintenance.

The wheel is a single steel forging. Unlike a built-up rotor there are no separate parts to loosen or work out. Since the effective steam action is at the backs of the buckets, wear does not affect efficiency.

Blades are notched in the centers to prevent destructive forces from being built up at the corners. The blades can't foul. They are protected at both sides by heavy rims and large clearances.

When you need continuous service, year in and year out, insist on Terry solid-wheel turbines.

THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD 1, CONN.



TERRY

SEND FOR THIS NEW BOOK!

Discusses in detail the design and performance of the Terry solid-wheel turbine. Ask for bulletin S-159.

TT-1222

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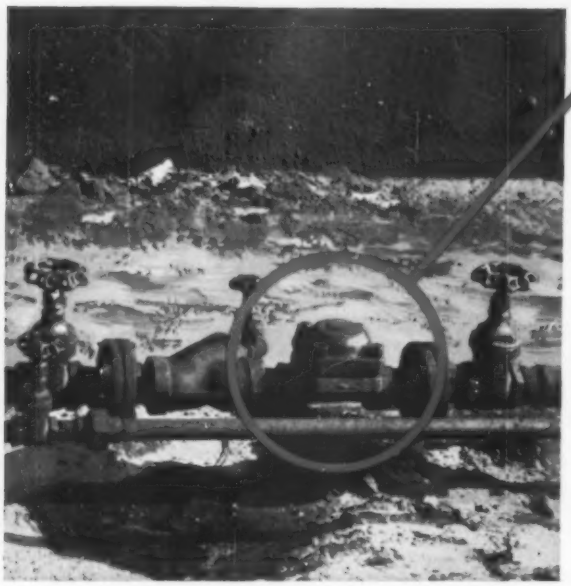
YARWAY Y news briefs

from **Yarnall-Waring Company,** *Philadelphia 18, Pa.*
BRANCH OFFICES IN 19 UNITED STATES CITIES • SALES REPRESENTATIVES THROUGHOUT THE WORLD • STEAM TRAPS STOCKED AND SOLD BY 270 LOCAL INDUSTRIAL DISTRIBUTORS



THIS STEAM TRAP WILL DISCHARGE 25,500 LBS. OF CONDENSATE PER HOUR

This is a typical installation of a Yarway Series 40 Impulse Steam Trap—a trap designed specifically to gobble up extra heavy condensate loads.

The trap is a No. 49, 3″ size, and is installed on a suction heater connected with an 86,000 barrel tank containing fuel oil at a storage terminal. The operating pressure is 13 psi. At this pressure the trap has a capacity of 25,500 lbs. continuous discharge of condensate per hour.

At operating pressure of 100 psi, the trap's capacity is 62,000 lbs. per hour.

CAPACITY—PLUS

Capacity isn't the whole story on Yarway Series 40 Steam Traps. Like all Yarway Impulse Traps, they offer advantages like quick heat-up, even temperatures, small size, good for all pressures, non-freezing.

Series 40 traps also feature high temperature discharge characteristics, excellent low pressure operation, no airbinding, operation against back pressures up to 40%, and stainless steel construction.

You can get Yarway's latest steam trap Bulletin T-1743, or arrange for a free 60-day trial of a Yarway Impulse Trap, by writing to Yarnall-Waring Company or contacting your local Industrial Distributor.

Yarway ½″ No. 40 Impulse Steam Trap (shown actual size). Also available in ¾″, 1½″, 2″ and 3″ sizes.

YARWAY OFFERS IMPULSE STEAM TRAPS FOR THESE SPECIFIC OPERATING CONDITIONS

AVERAGE CONDENSATE LOADS	EXTRA HEAVY CONDENSATE LOADS	LIGHT CONDENSATE LOADS
Series 60	Series 40	No. 30

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MERCER STATION CONSTRUCTION BRINGS INITIAL COSTS DOWN

Evolutionary design reflects trend toward outdoor stations at Public Service Electric and Gas Company

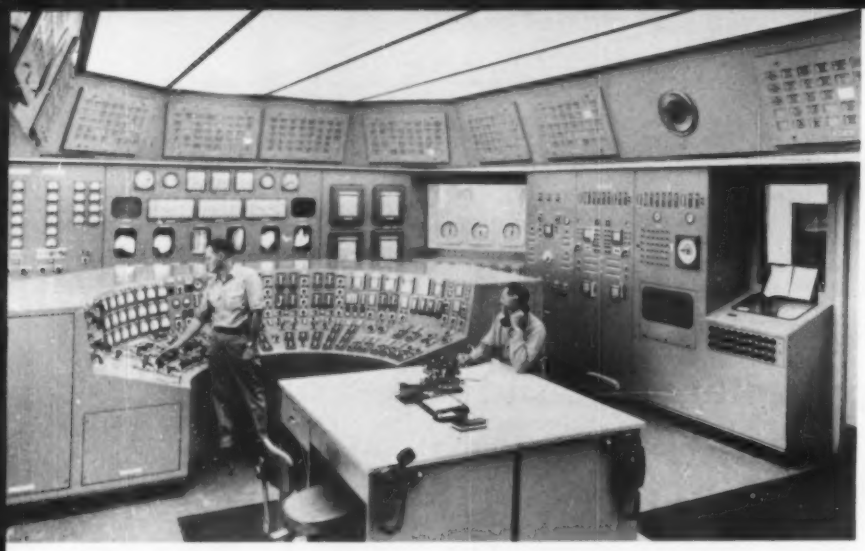
MERCER GENERATING STATION on the Delaware River near Trenton, N.J., became a 640-Mw member of the Public Service Electric and Gas Co. generating family when it was dedicated late September. During a pre-dedication tour by the technical press, the station's $110,700,000 cost was compared to that of its 580-Mw sister, Bergen Station (POWER ENGINEERING, Dec. 1960, p. 79), which cost $110,100,000. A big part of this lower initial cost per kw was attributed to placing the generators and shaft-driven boiler feed pumps out of doors.

"It is a step in the direction of the completely outdoor 400-Mw unit to be built at Hudson Generating Station for operation in 1965," said Robert I. Smith, assistant to chief engineer, Electric Engineering Dept.

According to Arthur R. Nelson, general manager, Electrical Dept., Mercer brings PSE&G capacity to 3827.3 Mw. The 14 units put on the system since 1947 added 2790 Mw, he said.

Since Unit 1 was started last

"Big switch" at entrance is handled by W. E. Karg, supt., during press tour. From left: A. R. Nelson, gen. mgr. Electric Dept., P. H. Hartung, supt. of gen., R. I. Smith, asst. to ch. eng. and Power Engineering's John Tyner



Half of the symmetrically arranged control room is nerve center for one unit. Data logger is at right

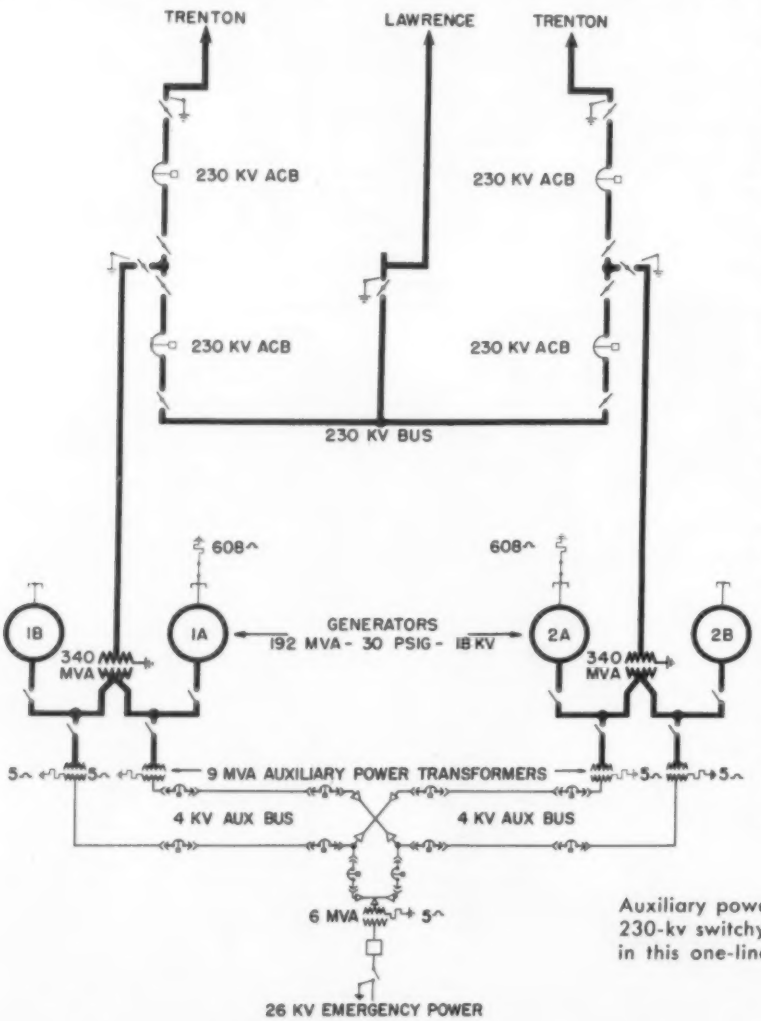
December and Unit 2 in May, the station has enjoyed an enviable operating record. William E. Karg, superintendent of Mercer, attributed this to thorough operator training (they spent at least a year at Bergen) and an insistence that all instruments and controls be in service before any start-up.

Both turbine-generators are cross-compound, 3600/3600 rpm, 320 Mw nominal at steam conditions of 2400 psig, 1100 F/1050 F. A half-capacity boiler feed pump is driven from the outboard end of each generator. The drive includes a variable speed hydraulic coupling and a speed increaser. The third pump is a quarter-capacity spare which can sustain full boiler pressure.

New to PSE&G power plants is the use of epicyclic gears (POWER ENGINEERING, March 1961, p. 52) in speed increasers. In the drive shafts of the two 7000-cfm, 300-psig centrifugal air compressors, the gears raise the 3600 rpm of the 2500-hp driving motors to 10,400 rpm. The shaft-driven boiler feed pumps' speed is increased from 3600 rpm to 8989 rpm, while the motor-driven spare's speed is raised from 3585 rpm to 8656 rpm.

It is possible to stop a shaft-driven pump for inspection or adjustment while the generator is running by withdrawing the fluid from the hydraulic coupling and applying a magnetic brake.

Each generator is rated 192 mva at 85 per cent P.F. with 30 psig hydrogen pressure. They are two-pole units, star-connected, and have a 0.64 short circuit ratio.

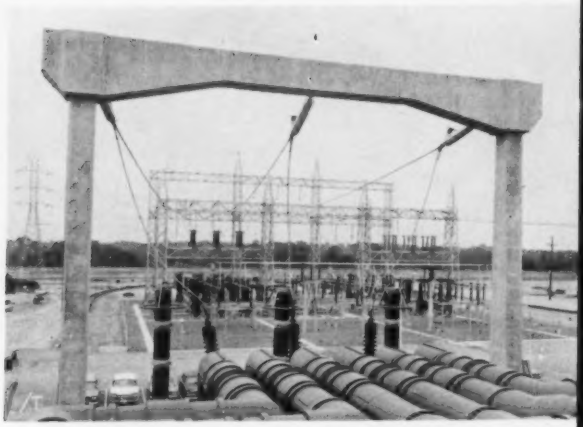


Auxiliary power buses, generators and 230-kv switchyard connections are shown in this one-line diagram

EACH UNIT is operated from a separate console in the air-conditioned control room. No liquid or hazardous gas-sensing lines are brought into the control room, all signals to indicators and controls being electrically or pneumatically telemetered. Closed-circuit TV monitors chimney emission, furnace burner conditions, boiler gage glasses and the main entrance gate.

A data logger in the control room continuously scans 600 thermocouple temperatures comparing them with predetermined set points. If values are encountered beyond these points, a red print-out of the time, point designation and temperature magnitude is made, and an alarm is sounded. After a temperature returns to its normal point, a black print-out occurs and an alarm is sounded. On demand, the unit will log out all 600 temperature points.

A digital, stored-program synchronous computer with 16,000-word



Prestressed concrete frame takes 1590-MCM ACSR from 230-kv transformer bushings to switchyard

Aluminum semi-gantry crane lifts housing from boiler feed pump installation on generator deck

capacity can calculate and print out station performance reports for weekly, monthly, quarterly and yearly records. It provides continuing operating guides such as unit rate and boiler efficiency from which actual operation is compared to bogie operation.

Steam is supplied by two identical, natural circulation 2,060,000-lb-per-hr boilers. Each has two pressurized, wet-bottom furnaces equipped with slag taps. Fuel is fired through 12 combination coal and gas burners on three levels in the front wall of each furnace.

Each furnace contains a radiant superheater which forms the upper portion of the four furnace walls.

Two variable-speed forced-draft fans supply combustion air to each boiler through the air heaters.

Flyash from each boiler is collected in eight economizer hoppers and 24 dust-collector hoppers, from which it is conveyed pneumatically by water exhausters to a dust silo, where it is stored for reinjection to the furnace, or to an air separating tank, from which it is sluiced to the ash disposal area. Flue gas dust is removed by combined mechanical electric collectors specified to have an efficiency of 98 per cent.

A completely automatic water-demineralizing plant treats the city water for boiler make-up.

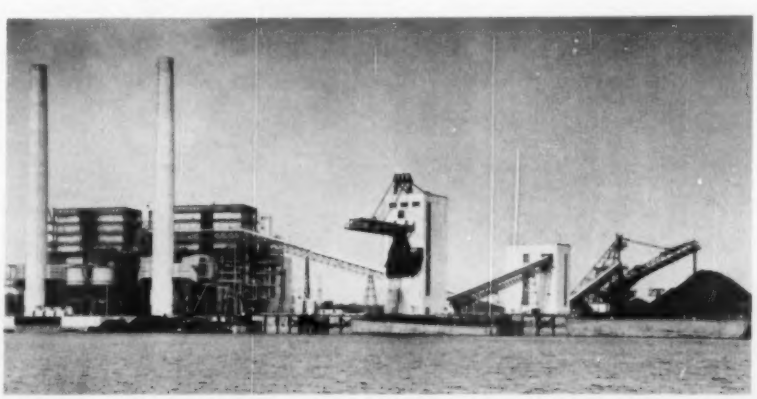
ELECTRICAL FEATURES. Excitation for each cross-compound unit is provided by a three-unit motor-generator set with two 500-kw, 375 vdc generators, one for each a-c generator. The 4.16-kv, 1450-hp induction motor is designed to provide a pull-out torque of 550 per cent at rated voltage. A flywheel increases the set's inertia constant to 5.0. The exciters are bridge-field type with the voltage regulator output connected across two arms of the bridge. A spare exciter was not installed because previous operating records indicated that this omission could be made with little risk and a substantial saving.

Each unit has two 4.16-kv auxiliary-power buses with three possible sources: 18-kv regular (a tap from the generator bus to the station power transformer through a disconnect), 26-kv emergency (emergency power transformer fed from a 26-kv overhead line which is connected to the bulk power system in Trenton) and 18-kv alternate (full-capacity cable tie bus which interconnects the auxiliary buses on one unit with those of the other unit).

Since the length of the 26-kv line limits its capacity, it could not be used for energizing an auxiliary bus nor for receiving a fully-loaded bus on transfer. This source can receive on automatic transfer, any or all of the auxiliary buses after scheduling load. Such transfer would occur on trip-out of a main or station power transformer, a main generator unit, or due to low voltage on the 230-kv system.

The 18-kv generator output is fed through isolated phase bus to two FOA 340-mva transformers in the 230-kv switchyard. The 230-kv switchyard is the first step in an extensive 230-kv transmission system which is presently being developed. Aluminum was used for both the transmission towers and the switchyard structures to reduce maintenance. Prestressed concrete suspension frames were used in the transformer area to simplify the transformer take-offs and to reduce capital costs.

The switchyard has three line and two generator positions which are protected by four five-cycle, 15,000-mva air-blast circuit breakers. All buses are welded tubular aluminum. END



Coal goes from barge and is processed to a 1 ¼ in. product and discharged to 13,000 ton active storage pile

POWER AUTOMATION COMES TO PHILADELPHIA

Philadelphia Electric Co. puts new economic dispatch system into operation

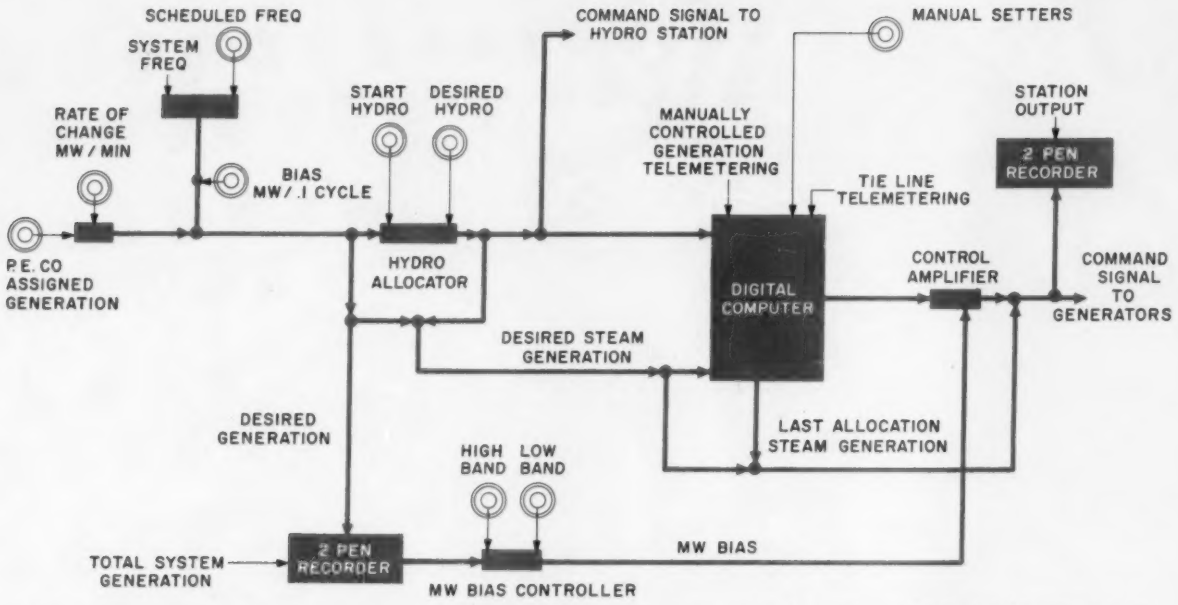
FIRST DIGITAL COMPUTER, to be used for economic dispatch control system, was recently put into operation by Philadelphia Electric Co. The equipment will be used to provide automatic load-control to 27 steam turbines and 7 hydro units.

This computer-directed control system was developed jointly by power engineers in Philadelphia Electric Co. and Minneapolis-Honeywell. For the first time, high-speed analog control elements are joined with an industrial process digital computer, the Honeywell 290, to perform the primary function of assigning generation at minimum incremental cost.

Of significance is the solid-state design of the system, which Honeywell was first to introduce. The only moving parts are relays, with an absence of motors, servos, slidewires and vacuum tubes.

Philadelphia Electric is one of eight members of the Pennsylvania-New Jersey-Maryland Interconnection (four other utilities have interconnecting ties), which operates under the principle of equal incremental generation and free flow of tie-line power interchange.

When the generation level is determined, P.E.'s power director manually adjusts a dial on the control console, for total assigned generation. So that assignment changes can be held to a rate equal to system response, the assigned generation signal is first sent through a rate-limiting circuit. A frequency bias component is then added. The re-



Block diagram of the automatic economic dispatch digital computer control system at Philadelphia Electric Co.

sulting signal represents the desired generation, including both manual and controlled steam generation and hydro generation.

ECONOMIC ALLOCATION. Next, the power director sets the level at which loading of hydro generation is to begin—when hydro cost is equal to the cost of the steam generation it replaces. At the same time, he selects the total amount of hydro generation.

Thus, the system allocates steam generation on an economic basis, considering transmission losses, up to the point where hydro loading begins, and holds steam load constant while varying hydro generation in this range; when maximum hydro is reached, the system assigns all additional increases to steam generation—at minimum incremental cost.

Desired steam generation, which is sampled every 10 seconds by the computer, is allocated by sending a portion of the total generation change to each unit, without regard to economical distribution. As units follow the change, the H290 computer rapidly samples generation and makes new economic calculations which reset the assigned generation among units.

While all generators initially start changing load to satisfy changing total generation, the total amount of each unit's generation is determined economically. A rate-limiter protects each unit by restricting its rate of generation change. Installed rated capacity of the Philadelphia Electric Company system as of June 30 was 3,459,850 kilowatts.

The H290 digital computer is the nerve center of the complex control system. Although primarily responsible for allocating steam generation on a minimum incremental cost basis, it computes, as a secondary function and on a time-sharing basis with dispatch calculations, data for interconnection billing. In addition, the computer is available for systems studies and calculations, including maintenance scheduling, on an off-line basis.

The load-dispatching control console is located in Philadelphia Electric's dispatching office, along with 10 relay racks and several printout devices. Manual setters and alarm indicators enable the power director to operate and supervise the entire system. A digital indicator enables the power director to obtain information at any time from the computer. Insertion of information *into* the computer is performed by a tape reader. Information *from* the computer is punched on tape and printed out on an electric typewriter.

Execution of the computer's commands between the dispatching office and generating stations, and control functions *around the computer* (if it is to be bypassed), is the responsibility of the load-frequency control system.

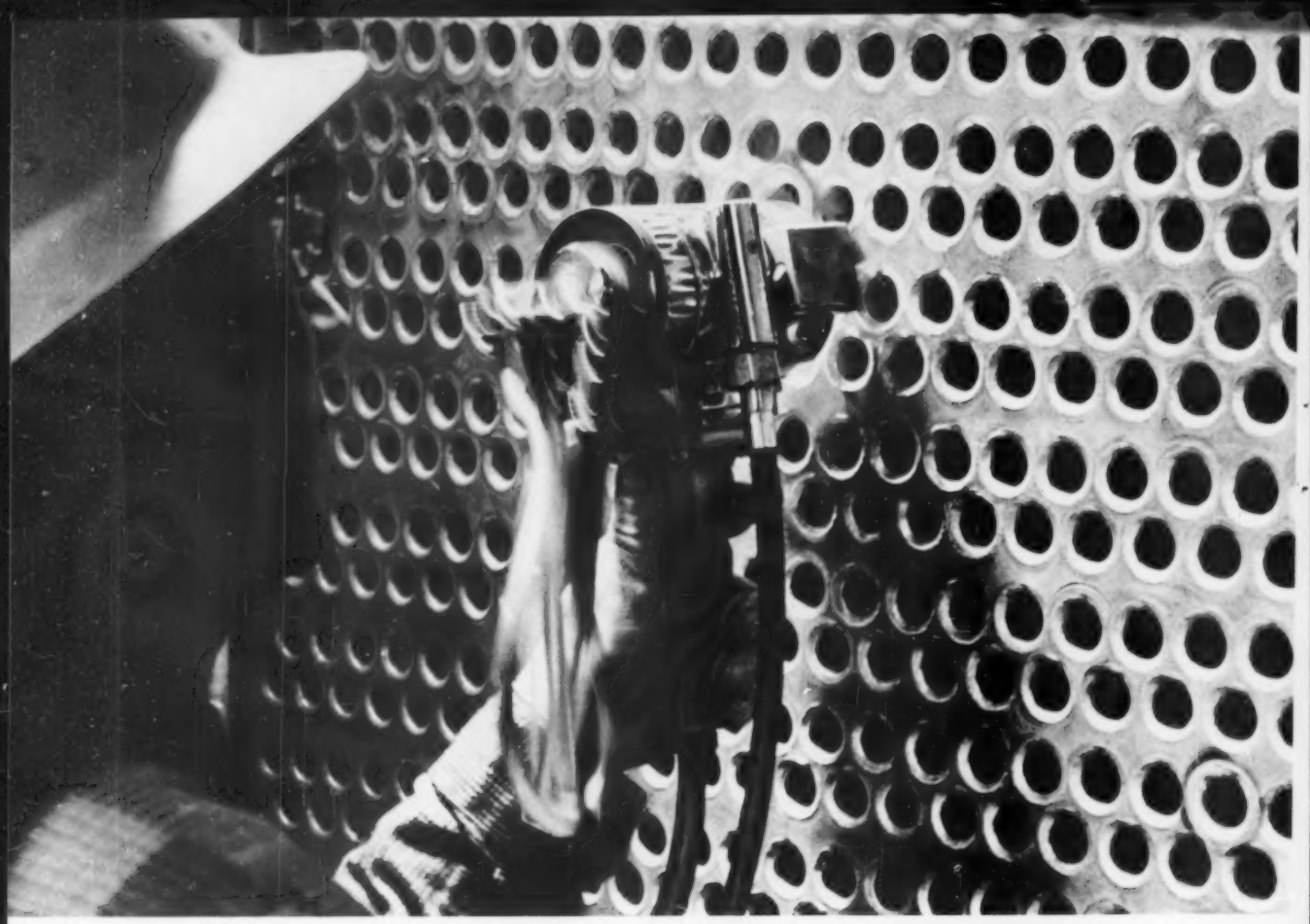
Changes that might occur in total steam generation, while the computer is calculating a dispatch, are passed around the computer and immediately allocated to units on the basis of their capacity. This makes proportional action around the computer possible.

An emergency bias circuit performs an auxiliary control function, without regard to economic allocation, in the event of loss of generation. In this way, a proper balance between desired, and actual, generation is always maintained.

When the computer is *off control*, the difference between desired and actual generation is fed to a supplementary controller, which allocates generation through the computer bypass circuits on the basis of the computer's last calculations or manually set allocations.

CHANNELING SIGNALS. All unit command signals, whether directly from the computer or bypassed around it, are fed to a high-speed variable-frequency telemetering system for transmission to generating stations. The Philadelphia Electric system employs fifteen channels, over leased telephone circuits. Some units are controlled individually while identical units are regulated together.

At each station, the command signals are fed to system control amplifiers which, in turn, control governor motor actuators. A rate-limiter prevents an actuator from moving a unit too rapidly. END



NEW CONDENSER TUBE WELDING SYSTEM FOR NUCLEAR PLANTS

INDIAN POINT has very low chloride requirements for the secondary water system, which makes it vital that the two-shell, single-pass condensers be completely leakproof. To achieve this, Consolidated Edison Co. specified welding of the condenser tubes to the tube sheets.

Located 24 miles north of New York City, the new nuclear electric generating station will be placed in operation this year. Ingersoll-Rand Co., manufacturers of the condensers, and Champion Construction and Engineering Co., Inc., erection contractors for the condensers, agreed with Consolidated Edison Co. on the choice of the lightweight automatic welding gun. Among its proved past performances was its use in welding cupro-nickel condenser tubes and condenser tube sheets in the main and auxiliary units of the *N.S. Savannah*. The world's first nuclear-powered merchant ship carries the first tube-to-tube-sheet welded condenser in marine service.

A permanent joint is effected by the welding gun by means of a rotating tungsten electrode operating in an atmosphere of inert gas. Used on a special joint design, the new process makes it possible to weld without addition of filler metal and obtains a consistently high tensile weld strength.

A ROTATING MANDREL ensures complete accuracy between the path of the torch and the periphery of the tube, with complete independence from slight inaccuracies in tube sheet drilling. Rotation of the mandrel is accomplished by means of a flexible cable from a variable-speed motor located at the power source. The torch is water cooled and is mounted to avoid tangling of gas and water hoses and electric cables.

Designed by the Welding Section of Revere Copper and Brass, Inc., Research Department in Rome, N.Y., the gun weighs only six pounds and may be used for joining any two compatible metals. Patent applications filed by Revere for the gun are pending. Adaptations of the gun are in use in connection with production operations especially in process industries. END

CONCEPT OF A DYNAMIC STEAM CYCLE

V. H. Pavlecka of American Machine & Foundry Co. describes a steam cycle employing axial compressors

ECONOMIC PRESSURE for higher thermal efficiencies has made the modern steam power station an extremely complex plant. In spite of this, the most recent installations are just about equal in efficiency to that of long-existing diesel engines. The reason lies, apparently, in pushing the steam-engine Rankine cycle to its limit in potential. This limit is relatively low in efficiency, and is also very costly to achieve.

Turbomachine development, particularly the success of dynamic compressors in jet-propulsion engines, has opened new vistas for use of thermodynamic cycles without boilers, economizers, or complex systems of water preheating by bleeding, to mention just three of the complexities of the Rankine cycle. Yet these dynamic steam cycles (DSCs) are capable of energy conversions at dramatically superior thermal efficiencies to the best now obtainable by conventional means.

Concept of the DSC was originated by the author soon after World War II, in a gradual process of study and clarification. Similar work has in the past few years gotten under way in Great Britain. The Central Electricity Generating Board started an independent DSC development, and has made excellent progress in the confirmation of some of its principles.

There is evidence, therefore, that the problem of up-dating the principles of power generation by steam is a timely one. For a long time, there has been an urgent need to explore DSCs experimentally and to make them useful to stationary, mobile, and motive power production. The DSC can also operate on coal, as do other steam plants.

Principle of operation of the DSC is simple: In effect, it is a cycle in which steam is first compressed, then superheated, and subsequently expanded before repetition of the recompression. A part of the expanded steam is condensed, and the water from it is then injected into the steam between compression steps. Latent heat of evaporation is used for cooling the process of steam compression. This basic cycle may have many diverse forms and refinements, all of which use compressors rather than boiler feedwater pumps for raising pressure.

Reasons for the high thermal efficiency of DSCs are numerous, a significant one being the influence of greater weight-flow in use at high temperatures and smaller weight-flow at the lowest (or rejection) temperature. Another factor influencing thermal efficiency is the small heat rise in the compression of steam as compared to the large heat drop in steam expansion. In relation to air, or other gas cycles, the energy conversion capability of water-steam is superior to that of other gases. Using steam instead of air in what originally was an air cycle (gas-turbine cycle) also influences efficiency favorably.

Owing to high thermal efficiencies, the condenser of all DSCs will be smaller than those in Rankine cycles of equivalent output. Simplicity and comparatively small size of a DSC power plant are even further favorably reflected in costs by the reduced investment in the cooling facilities.

One further advantage of the DSC remains to be noted: Its turbines operate from lower-than-critical pressure levels, but with heat drops comparable to those of Rankine cycle turbines. These turbines do not have miniature blades on the high-pressure stages or propeller-like blades at the exits. Because their diameters are large (compared to the small diameters of high-pressure stages of present steam turbines), they will accomplish the same heat drops in fewer stages than is presently possible. The turbines will be similar to gas turbines, but will produce more power with the same pressure drops across each stage.

A TYPICAL high-efficiency high-pressure DSC is illustrated in Figs. 1 and 2. Maximum cycle weight-flow of near-saturated steam leaves the last compressor (B) at state 1, is then superheated to state 2 in heater H, and is finally expanded in turbine I to state 3. In this loop, defined by states 1-2-3-12-1, the maximum weight-flow in the whole cycle is used. At state 3, a part of the steam continues into the reheating part of superheater H, where it is reheated from state 3 to state 4. This state (4) is at approximately the same temperature as that of state 2 and from it the steam is ducted to output turbine J. The remainder of the steam at state 3 is cooled to state 12 in desuperheater F; here, the steam from state 3 is mixed with water spray of state 15 and also with the wet steam of state 11, which arrives from compressor A. The mixture at state 12 then enters compressor B, where it is raised back to state 1.

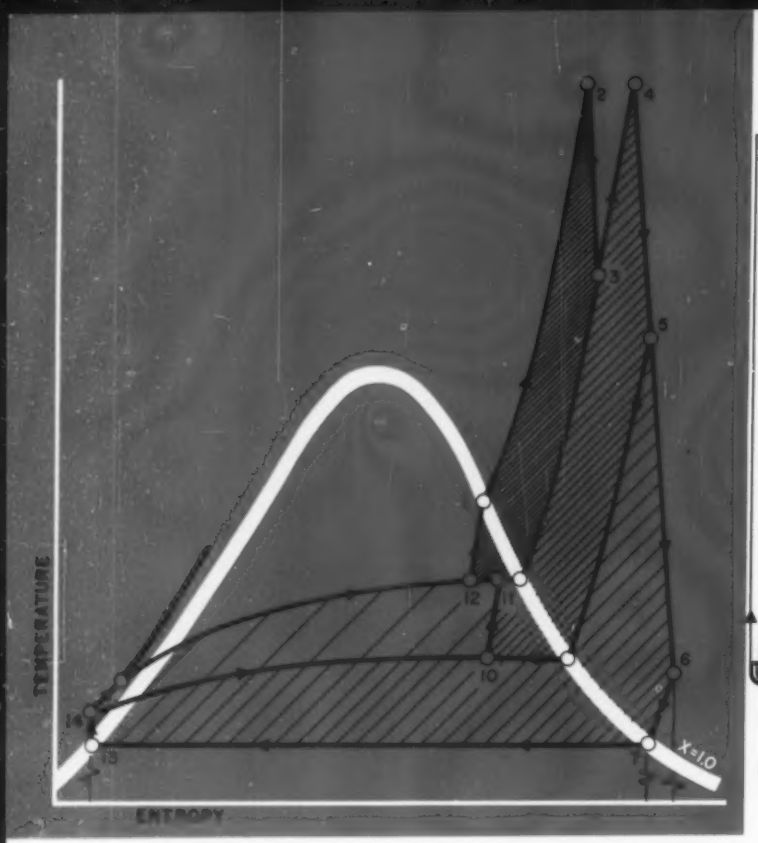


Fig. 1 (1). T-S diagram of a typical DSC

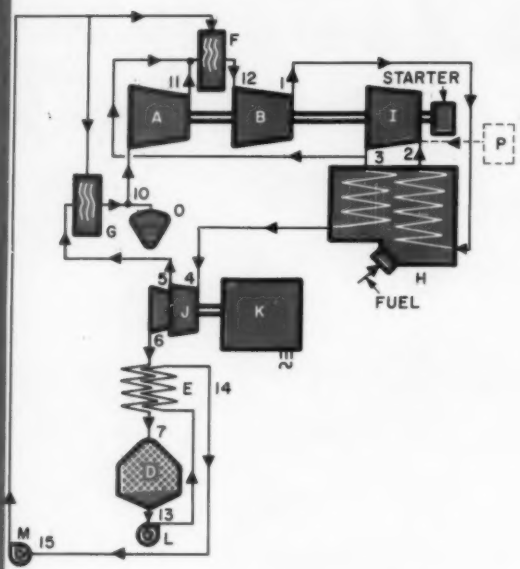


Fig. 2. Circuit diagram of a typical DSC

A SIMILAR DIVISION of steam weight-flow may occur several times during expansion, although it is shown only twice in the diagrams. The second steam division takes place at state 5 in turbine J. Again a portion of the partly expanded steam is ducted away into desuperheater G, where it is quenched to state 10 and then compressed to state 11. Cycle area 11-3-4-5-10-11, therefore, operates with a lower weight-flow than does area 1-2-3-12-1, but with greater weight-flow than does area 5-6-7-13-14-15-10-5.

Evaporator O, situated in front of compressor A, is provided for starting purposes. Power for motoring compressor set A-B-I may originate from a steam turbine or an electric motor. The best starting procedure is a direct supply of steam from small boiler P to turbine I. This steam will provide the initial steam weight-flow as well as the motive power for rotation of aggregate A-B-I. In either case, the make-up steam is provided from either boiler O or boiler P.

Last turbine (J) is smaller than is the case in a comparable Rankine system. This is true in spite of the fact that the exit steam at state 6 is higher in temperature than it is at state 7. Reducing the size of turbine J still further is possible by selecting such cycle parameters that state 6 falls on, or even below, the steam saturation line. Water reheat 14-15 may not be used or, if it is used, may be accomplished by bleeding steam from turbine J. Almost limitless possibilities are feasible with these cycles because of their diversification.

Superheating of steam has to be partially carried out in radiant superheaters. Such steam superheaters are already in use and have been used in air cycles up to temperatures of 1300 F. With steam as a better coolant than air, there should be no difficulty in DSC operation at similar temperatures. By using some of the established cooling methods in DSC steam turbines, much higher temperatures become feasible than were possible previously in high-pressure turbines.

USE OF THE DSC for extraction of heat from atomic reactors is very promising. By cooling the reactor core directly with dry steam, very simple systems can be obtained without heat transfer losses. So far, without a single exception, the burden of economic operation has been put exclusively on the reactors, while the thermodynamic loops have retained conventional design. The DSC is capable of immediately altering this situation for the better at a lower investment cost. The costliest equipment in the British nuclear power stations, for example, has been the gas-steam heat exchangers.

IN ALL ITS CONFIGURATIONS, the DSC is based on progressive return into the cycle of a portion of rejected heat. This is accomplished by water spray into superheated steam, a process which does not suffer from pressure drops and does not require structural heat exchangers. The ideal use of this compression-cooling method is, of course, to cool directly in the compressor. The water can be introduced into the stators of an axial compressor (the British have already succeeded in compressing wet steam in axial machines), thereby reducing the work of compression. This is important in small output DSCs, as shown in Figs. 3 and 4, although this can be accomplished in large-output installations as well.

Vapor of state 1, Fig. 3, is compressed in axial compressor A (Fig. 4) to state 2. During compression, water from heater E is brought into manifold G and is distributed by it to the stators of the compressor. The water is injected as atomized fog into the steam stream. This compression process is indicated in an approximate manner in Fig. 3, which shows a mean path of com-

pression from state 1 to state 2. The compressed steam, before entering turbine B, is preheated by heater D to state 7 and by superheater C to state 3. Here, the full flow of steam expands to state 4 before entering the heat exchangers (D and E).

BEFORE ENTRY into condenser F, a larger part of the steam stream is ducted away to compressor A. The condensate is delivered by pump G back to heater E, etc. In this form, the DSC may be used for small outputs with a thermal efficiency higher than that of contemporary gas turbines, which must be operated at temperatures much higher than those used in a DSC. The DSC can accomplish this at temperatures so low that gas turbines, under similar conditions, would not even operate. DSC power plants will have heat exchangers not much different in size from those used in low-pressure gas turbines.

Recently developed combinations of air cycles with steam cycles are also applicable to the DSC, particularly because the DSC will not have economizers. Thus it will be very easy to join the DSC to an air cycle. It is possible to obtain simple load-responsive controls of DSCs for constant-speed, torque-responsive operation that no longer requires partial steam admission to the first turbine.

DSCs will contain very small amounts of water and steam, the total fluid weight usually being less than 20 per cent of the entire water-steam content in conventional steam cycles of comparable output. DSCs will, therefore, be capable of rapid run-ups from cold state, and will be quickly load-responsive. Over-all size and weight will generally be smaller than is now common in steam power plants.

Capital cost compares favorably with conventional steam power plants despite the need for compressors. Light weight and compactness will substantially reduce the cost of foundations, buildings, cooling towers, access channels, etc.

IN VIEW OF the immense gains immediately possible with DSCs in terms of power cost reduction, it is surprising that so far no interest in it has been generated in this country. This is particularly astonishing inasmuch as considerable sums are being spent by public utilities on long-range magnetohydrodynamic (MHD) research. Aside from its immediate applications, it appears that the DSC will be indispensable to the operation of future MHD power plants. END

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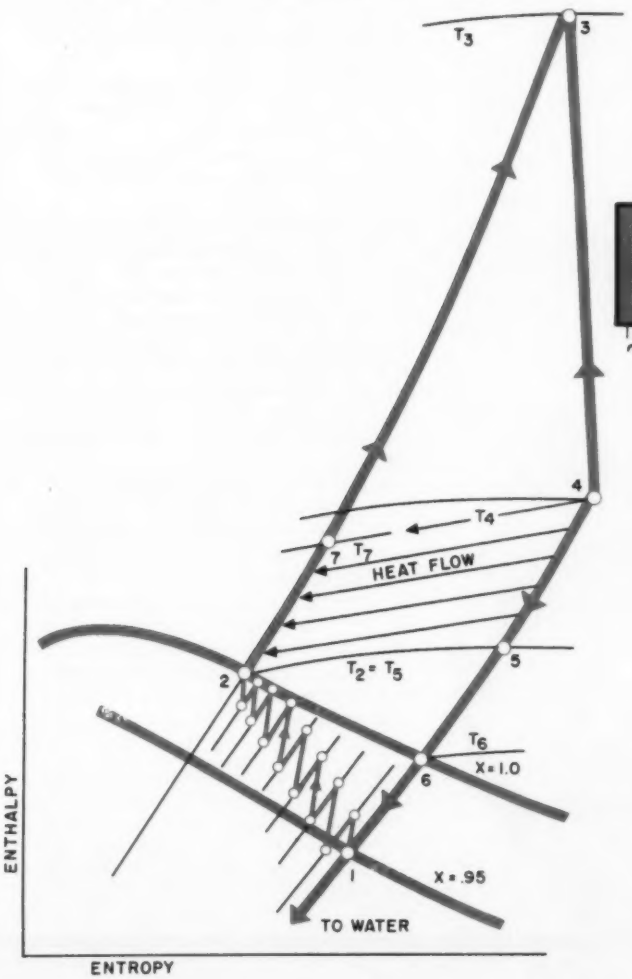
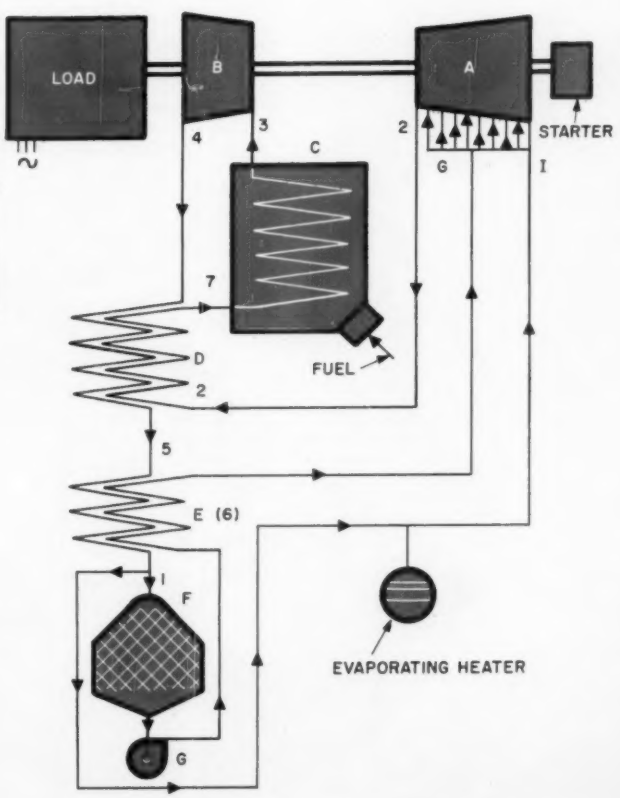


Fig. 3 (left). I-S diagram of DSC with quenched compression

Fig. 4. Circuit diagram of DSC with quenched compression



ANOTHER TEST OF THE BARE-HANDS HOT-LINE METHOD

Editor tries new technique, and finds it safe and efficient

WE WANTED TO CHECK, through personal experience, to see if the new bare-hands method of working "hot" transmission lines is as safe and practical as it appears to be. So — what could be better than an actual experience with the Holan crew, who have been demonstrating the technique (and equipment) for some months (see POWER ENGINEERING, June 1961, p. 62).

Having once worked on a "hot-stick" crew, Editor Bob McCaw was intrigued by the new bare-hands' philosophy when it was first announced. (It will be recalled that this scheme was jointly developed and tested by American Electric Power and Ohio Brass Company.)

After the Holan Corp. (an Ohio Brass subsidiary) started a demonstration team on the road, we made arrangements to participate in an actual performance of line maintenance work. After following the crew for several months, we were finally able to contact them during a demonstration made for an Eastern utility company.

EXPERTS WITH PERFECT EQUIPMENT. Demonstrating both the Holan truck (with insulator-elbow) and the bare-hands method, the team of Daryl Gaiennie and Ted Derryberry did an outstanding job of proving their point. The system and equipment are *really the answer* to hot-line maintenance, in our opinion.

After an excellent talk (plus on-the-scene photo slides) by Mr. Gaiennie, the group of utility power engineers went out onto transmission line locations for actual demonstrations. (This demonstration team doesn't just *make contact* with a hot line; they actually *perform a maintenance job* for the host utility company.)

Some very complicated jobs have been efficiently performed by this team of experts, including insulator and cross-arm replacement, etc. The demonstration we participated in was one involving the replacement of phase-isolators with permanent line connector sleeves. Significantly, it was a job that would have been almost impossible to perform with hot-sticks.

Top photo shows two completed splices, and isolators removed. Middle view is of two utility executives, in another aerial lift, observing the hot-line activity. Note jumper around the isolator

After two phases had been effectively spliced out, Editor McCaw went aloft in the Holan insulated "cherry-picker" boom to test the reaction to hot-line, bare-hands contact. After following the simple rules of attaching the basket ground-clamp (and staying clear of the cross-arm), contact was made with the energized 12,500-volt conductor.

The simple fact that this story is being written is proof enough that *the method is perfectly safe!*

SAFETY IS NOT ENOUGH. In all high-tension maintenance work, *safety* is the first rule to be observed. However, this is not enough to justify the purchase of expensive equipment just for the performance of hot-line maintenance. In addition to the *increased safety* offered by the equipment (and method), a tremendous time-saving is gained. And many jobs, impossible to perform with hot-sticks, can be quickly and efficiently performed.

As the Holan crew has done job after job, for utilities around the country, they have amassed a wealth of on-the-job performance records that are almost unbelievable. By comparison with conventional hot-stick methods, they have accumulated time-savings ratios as high as 100 to 1. Better still is the fact that many maintenance jobs, impossible to perform with hot-sticks, can be done most effectively with this new equipment and method.

NEW TOOL TESTED. Despite the speed with which the Holan truck can put linemen safely in a position to work on hot lines, some operations just require a lot of time to complete. One of these was the making of an ordinary line compression splice.

Since all tools must be kept at the same potential as the conductor (and the lineman), it was formerly necessary to make all splices with hand-operated compression tools. This got to be a "man-killing" job if many splices were involved. So a new tool was indicated.

On this particular job, we tested a brand-new device, developed specifically for hot-line work by the Burndy Corp. It is a power-pack unit, which furnishes high-pressure *hydraulic* power, through non-conducting hose lines, to standard press units — long used for making line splices. This unit consisted of a 12-volt battery pack, plus a motor-pump unit which developed hydraulic pressure sufficient to operate the sleeve press. The unit is a portable, electrically-operated HYPRESS pump of small size and light weight. (We predict this unit will do great things in line maintenance work because it is such a terrific labor-saver.)

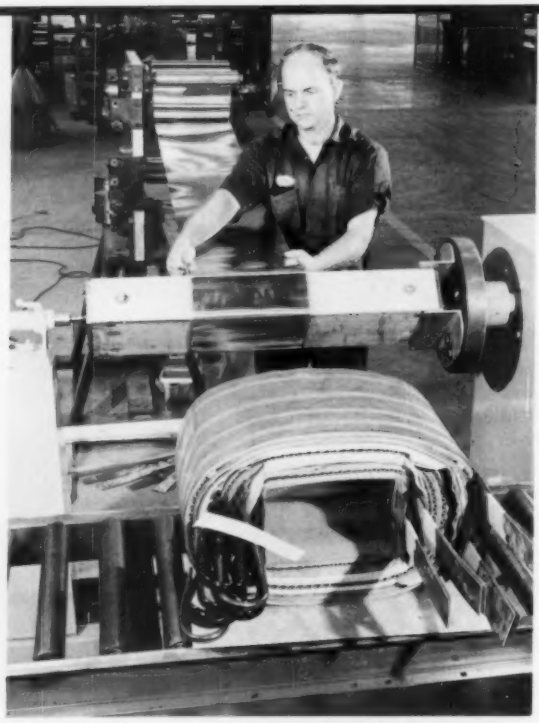
Two views of Ted Derryberry, of Holan Corp., and Power Engineering's Bob McCaw—in contact with a live 12.5-kv line. The bottom view shows Holan crew in action, with utility executives observing

It is understood that the Holan Corp. is developing insulated "elbows" for the EHV lines, and that a test demonstration will be made on up to 750-kv conductors We hope that after the *birds* have proved such voltages safe to perch on, we can test it — and tell our readers that it's okay to work on, *while hot*. END

Members of American Nuclear Society tour Homestead Works of U.S. Steel during Society's recent meeting in Pittsburgh. Here they watch preparations for machining a 21-ton pressure-vessel flange forging on the 20-ft vertical boring mill at the plant's forge division

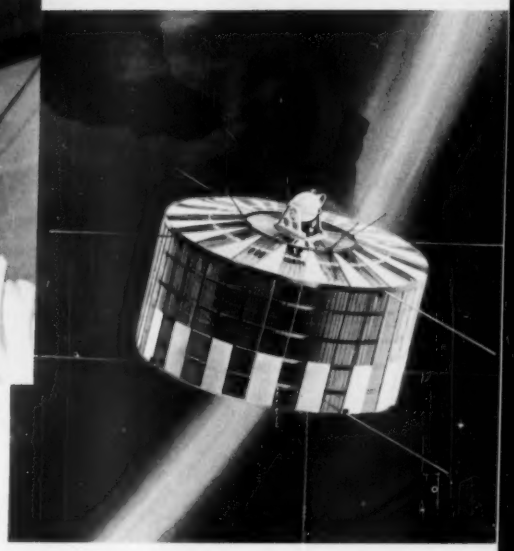
Power Engineering's

This small coil of wire is Westinghouse's superconducting magnet. It's twice as strong as iron-core magnet of 40,000 lb, runs from auto battery



Winding aluminum strip coils for distribution transformers in the new plant of H. K. Porter Co.'s Delta-Star Electric Div. at Lynchburg, Va. Plant includes high-voltage high-current surge laboratory for all standard tests

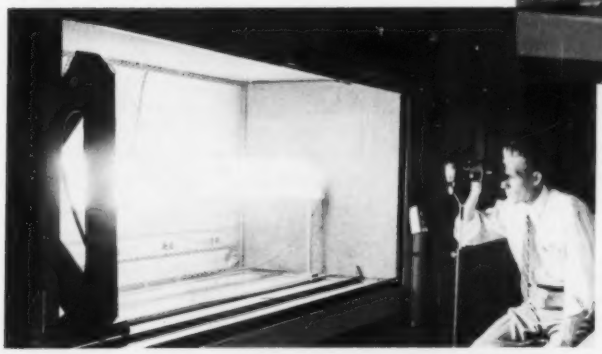
Nuclear power plant, a tiny radioisotope-fueled SNAP generator made by Martin Co., is fastened to base of the latest Transit satellite



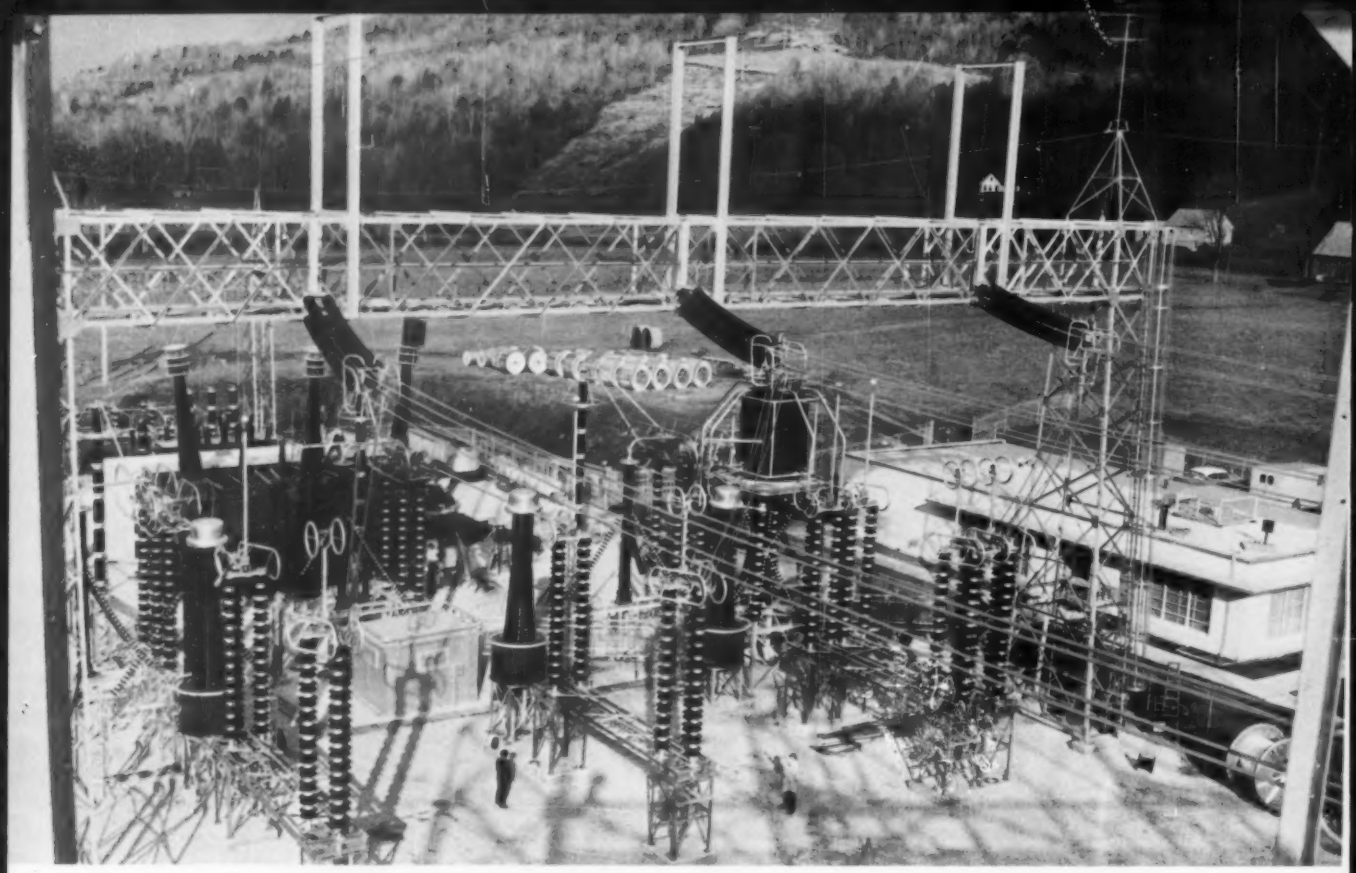
NEWS REEL

New plant of Southern Electric Generating Co. at Wilsonville, Ala., has initial capacity of 1,000,000 kw

Thermoelectric laboratory device at General Dynamics converts heat from a gas flame directly into electricity for light in a gas refrigerator. It's the forerunner of small, low-cost generator



Equal to 400 60-watt bulbs, this new GE mercury-fluorescent lamp is rated nation's most powerful



SYSTEM DESIGN AND OPERATION OF "PROJECT EHV"

In this article, Dr. Abetti concludes his discussion of the project, and tells of the research objectives

NORTH STATION STRUCTURES are all made of aluminum—the two terminal towers, equipment stands, buses and the fence. Aluminum was selected because of its light weight, ease of erection, and freedom of maintenance. An over-all view of the North Station is shown in Fig. 1 (above). The 650-kv terminal structure is 68 feet high and 123 feet wide.

First three towers are of the portal-type (Fig. 2a), 77, 129, and 116 feet high, and from 176 to 190 feet wide. Tower number one, adjacent to the North Station, has a passenger elevator to facilitate access to the many instruments which are installed at various locations on the tower, and to the closed-circuit TV camera. These portal-type towers weigh about 80, 140, and 130 tons.

The other 15 towers have been designed for maximum economy, and are mostly of the conventional *corset-type*. Figures 2b and 3 show the outline of a typical steel suspension tower weighing about 15 tons. At 500 kv, all three phases are free-swinging, as in most transmission lines, and the interphase spacing is 38.5 feet. At 650 kv the center phase will be restrained from swinging by two insulator chains in V-connection, and the interphase spacing will be increased to 45.5 feet.

The V-string connection has been used successfully in Canadian and French transmission lines and presents certain advantages and economies, particularly in the width of the right-of-way. However, it may also present special problems, which deserve to be investigated further. Economic studies have also shown that there are practically no additional gains in using V-string connections also for the outer phases.

This convertible design is of interest to those utilities which wish to operate an extra-high-voltage line *initially at a lower voltage*. Most towers are steel, using various designs and grades of steel. Two towers are aluminum, one self-supporting and one guyed (Fig. 4); one glued laminated wood (Fig. 5); and one prestressed concrete (Fig. 6). The latter two present special problems in regard to corona, RI, and leakage currents; and an extensive series of tests were made on sample beams in the Pittsfield High-Voltage Laboratory.

Span lengths vary from 880 to 2175 feet, with average span length of 1300 feet. The 2175-ft span is used to study aeolian vibrations; and, for the purpose of facilitating the emergence of these vibrations, the tension of the conductors on the long section are 22 per cent of the ultimate, somewhat higher than in most American EHV lines.

The long section of the line is designed for one-half-inch ice, 4-lb-per-sq ft wind and a safety factor of 2.0, in accordance with American practice for heavy loading. No broken conductors are assumed in determining the tower loadings. Two

ground wires, 203 MCM, are used, with a protective angle of 25 degrees for the two outer phases. Two aluminum rods are placed on each tower, over the ground wires (Figs. 2a and 2b), to attract lightning. These rods are 40-ft high on the three portal-type towers, 20-ft high on the other 15 towers.

Lightning is measured by cathode-ray oscillographs, teinographs, and magnetic links. Four per year is the average estimated strokes that may occur on the entire line. In addition, a high-capacity impulse generator is installed at tower number 2, rated 3,000,000 volts and 250 kw/sec. It is housed in an inflated plastic dome, as shown in Fig. 7. Tests will be made of attenuation of traveling waves and of their penetration into the two terminal stations during fair and foul weather. Tests are also being made regularly of the flashover strength of long insulator strings, as a function of the weather.

In the past, experimental lines carried only *charging current*, and the conductor temperature was the same as the ambient. A limited series of tests made at Tidd have shown that corona loss, and presumably RI, *may be considerably affected by the load current*. In order to study the effect of normal and overload currents on the line performance, current will be circulated on one phase within the 2-conductor and 4-conductor bundle configurations, up to 800 amp per conductor in the bundle, corresponding to approximately twice the surge impedance loading.

This current is obtained by applying about 3000 v between the bundle conductors separated by insulated spacers. This may be a practical way of sleet-prevention in exposed sections of bundle conductor lines.

In addition to the 3-phase EHV line, 4.3-miles long, three short 3-phase lines, each 400-ft long, are being built at the South Station. In each line, one phase will consist of the single 2.32-in. expanded conductor, another of 2 x 1.465 in., and the third of 3 x 1.19 in. conductors. These are the configurations which will be investigated at 460-500 kv. Each short line will be aged for at least 12 months, at three different voltages: 460 kv, 115 kv, and no voltage (under identical meteorological conditions.

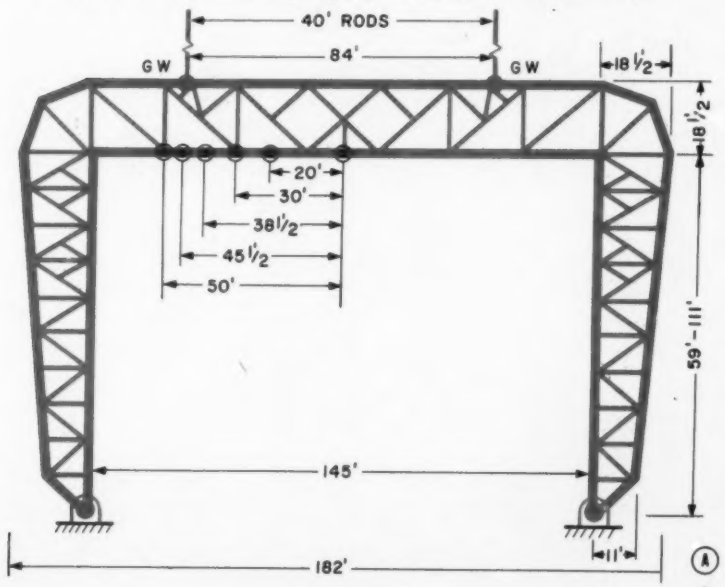
Conducted radio-interference voltage (RIV) will be measured continuously on the three phases, energized at 460 kv. After 12 months, the conductors which had been aging at 115 kv will be energized at 460 kv, to measure their RIV, and later the conductors which had been aging at no voltage.

RESEARCH OBJECTIVES. In addition to proving the reliability of the line and apparatus for service under representative conditions at 500 and 650-750 kv, one of the main objectives of Project EHV is the collection of experimental data. This will be done on a much larger scale than on other experimental extra-high-voltage lines. In order to obtain maximum efficiency and accuracy at minimum cost, almost all data to be measured at regular intervals of time is acquired, transmitted, and processed automatically.

Measurements are made at the five test locations, numbered from the North Station, and spaced at about equal distances along the line. These measurements are 267 in total, of 47 different types, and may be subdivided into *electrical* (133, of 13 different types such as corona loss, RI, etc.), *mechanical* (71, of 11 different types such as strain and stresses in the conductors and towers, aeolian vibrations, etc.), and *meteorological* (63, of 23 types such as temperature, pressure, etc.).

All quantities are measured which are of interest to determine the electrical and mechanical performance of an extra-high-voltage line; also many quantities which may affect this performance. For instance, aerosols (small particles floating in the air) are investigated because presumably they influence RI and corona loss.

In total, 158 measurements, of 35 different types, are obtained through the digital data acquisition system shown in the simplified block diagram of Fig. 10. The first link in the automatic system is the transducer, which converts the quantity being measured into an electrical quantity, such as voltage. Whenever the transducers are accessible (e.g., the 23 RI meters), they are connected to the remainder of the system by means of shielded wires. In some cases, transducers are located directly on the energized conductors (e.g., strain gages), and their output is brought to ground by special radio telemetering equipment, designed to operate from batteries



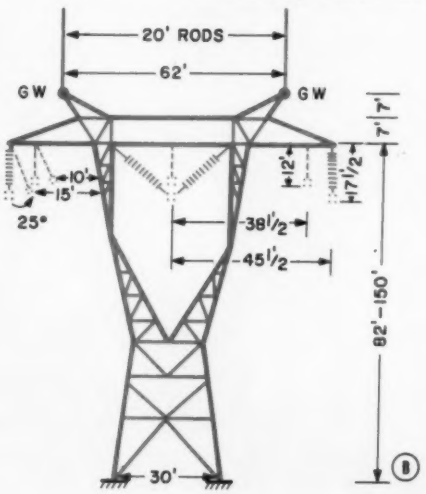


Fig. 2. Outline of 500-650-kv steel towers for the short section (A) and for the long section (B) of the Project EHV line

which will be recharged every 30 days.

Output of the transducers may vary slowly, or rapidly, with time. Instantaneous values are recorded of slow-varying quantities (such as barometric pressure), but the rapidly-varying quantities are processed in an analog computer, to obtain the *maximum* value. Conductor sag and swing, average value of RI and corona loss, and wind velocity and conductor tension are examples.

Data is then processed by the General Electric Type 310 Data Acquisition System, which is capable of taking 250 readings at a rate of 240 per minute, either once every 20 minutes in fair weather or once every two minutes in foul weather. The decision between these two cycles is made automatically whenever the system detects that certain quantities are outside arbitrary limits (say when wind velocity exceeds 30 mph), or on demand from the control building at the North Station.

The programmer controls the operation of all the components in the system. At the end of each cycle, it commands the three scanners to scan the quantities being measured. These quantities are attenuated to the proper range, and are digitalized by the analog-to-digital converter at each station. The digital outputs are transmitted, by shielded cable lines, to the control building, and are recorded on three paper tapes. These paper tapes are then read in turn, off-line, and the output typed out on a flexowriter.

Every two weeks, the paper tapes are converted to magnetic tape, and the data are processed through an Electronic Data Processing Machine of the Power Transformer Department. This computer will process about 10-million measurement data yearly. It will scale all data, check their validity, determine statistical averages, standard deviations, and (by using multiple regression analysis) correlation coefficients—to show the dependence of any variable on any other. It is believed that the system outlined above will obtain this unprecedented amount of data, in quantity and type, at the lowest cost, in the shortest time, and with maximum accuracy.

Fig. 3 (left). Corset-type steel tower for long section, number 6

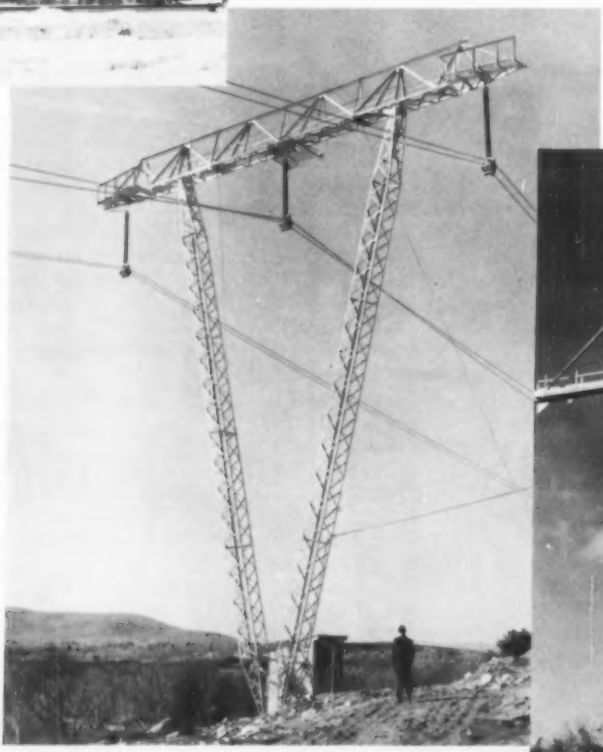


Fig. 4. Guyed aluminum tower, no. 8

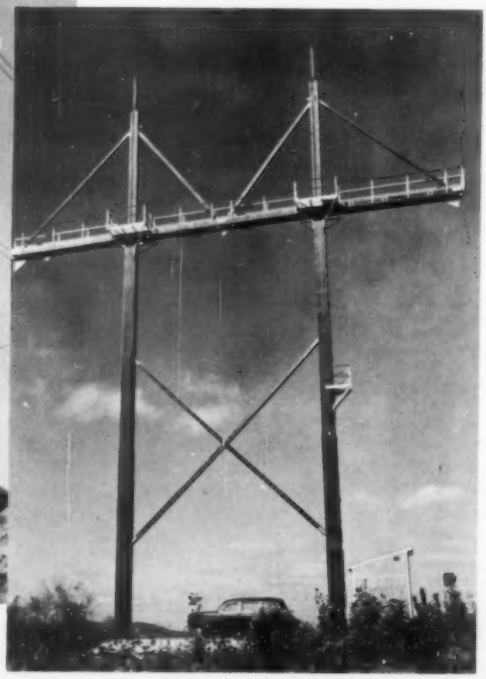


Fig. 5 (right). Glued laminated wood tower, number 14

ADVISORY COUNCILS. It is clear that practically all the technical problems which will be investigated within Project EHV are of direct interest to the utilities. The close association between electric manufacturers and utilities of the U.S. and Canada has enabled the manufacturers to be always alert and cognizant of the challenges facing their customers, and thus offer their facilities, knowledge and services for solving the utilities' problems.

Therefore, it is extremely important that the utilities take a leading part in determining the nature, scope and timing of the Project EHV research investigations. With this purpose in mind, the General Electric Co. approached the Edison Electric Institute (EEI, the association of investor-owned American electrical utilities), in 1958, asking them to name an Advisory Council for Project EHV.

EEI appointed a Task Force on EHV transmission, consisting of prominent engineers from nine major utilities of the United States. Subsequently, the General Electric Co. named three representatives from American *government-owned* utilities and three from *Canadian* utilities, since these two groups are not represented in EEI. In 1959, a Committee of Consulting Engineers, consisting of 15 representatives of consulting firms in the U.S., was appointed. About three meetings are being held every year with these groups.

CONCLUSION. The objectives of Project EHV are: (1) To help re-establish the United States as a world leader in the broad area of EHV power systems; (2) to help prove that extra-high-voltage systems above 345 kv, in all their interrelated components and aspects, are feasible, more reliable, and more economical for the transmission of large blocks of power over narrower rights-of-way than systems presently used; and (3) to contribute technical knowledge which will advance the continued expansion of electric power at reduced costs.

Operating experience to date, during four months of severe winter weather, has been excellent from all points of view. While it is too early to draw any conclusions from the data which are now being analyzed, it can be stated that the corona loss and the radio-influence level are somewhat lower than has been calculated.

As an example of the results obtained, Fig. 9 presents the conducted radio-influence voltage (RIV), measured on the Project EHV North Station, as a function of the voltage, at the reference frequency of 1 megacycle. It is seen that *doubling the voltage* increases RIV *only* 15 decibels. The contribution of the North Station to the total radio noise of the Project EHV line is negligible, as had been specified in the design criteria.

Figure 8 reproduces the corona loss, recorded at 500 kv, on the center phase of Project EHV, strung with 2.32-in., 2995 MCM, special expanded conductor, from 2 to 5 p.m. on December 8, 1960. To convert the loss values indicated on the ordinate to 3-phase-per-mile values, a multiplier approximately equal to 4.5 should be used.

It is seen that, initially, the sun was shining and the losses were negligible, less than 3 kw per 3-phase per mile. As the sky clouded up the losses increased slightly. Suddenly a violent snowstorm was noticed advancing upon the line. This blizzard lasted only about half an hour, and the losses increased to about 78 kw per 3-phase per mile, 26 times the fair-weather value. The snowstorm ended as abruptly as it started, but the conductor re-

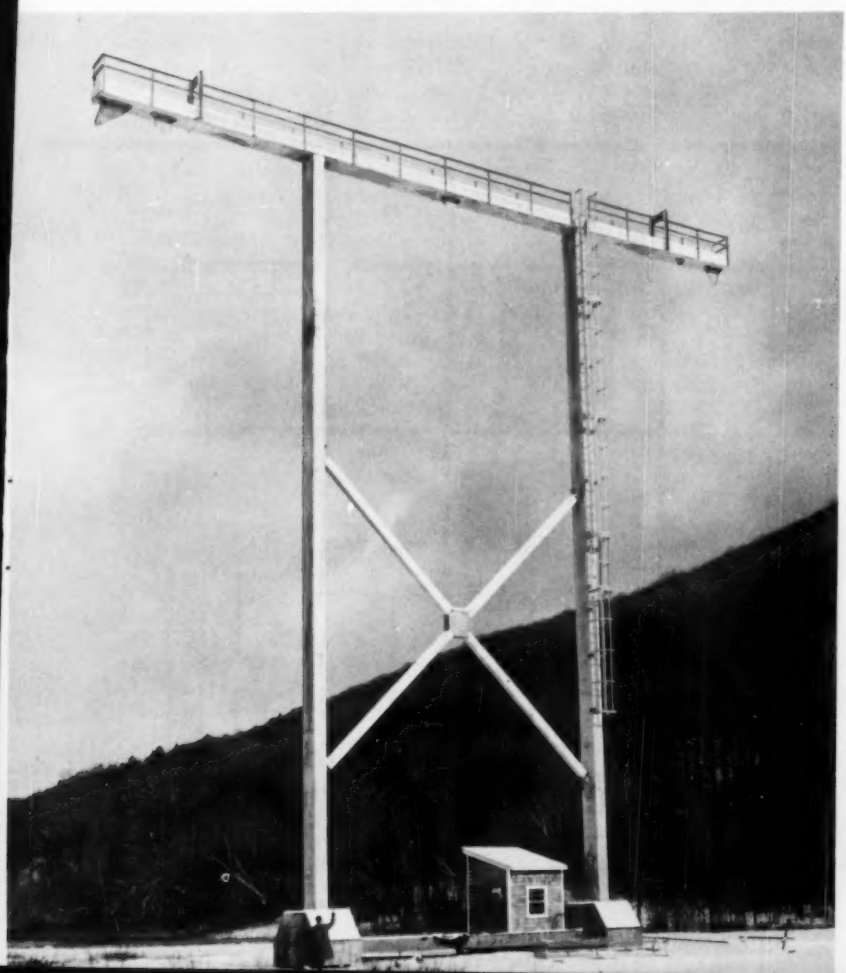
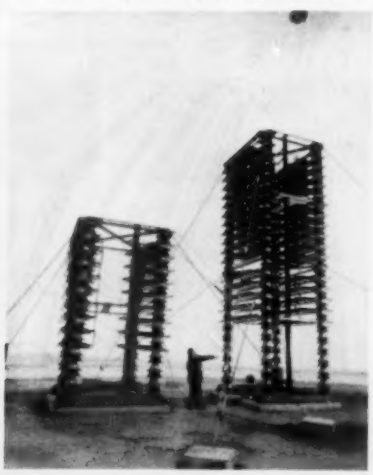


Fig. 6. Prestressed concrete tower, number 12

Fig. 7. Interior of inflated plastic dome with 3,000,000-v and 250-kw/sec impulse generator



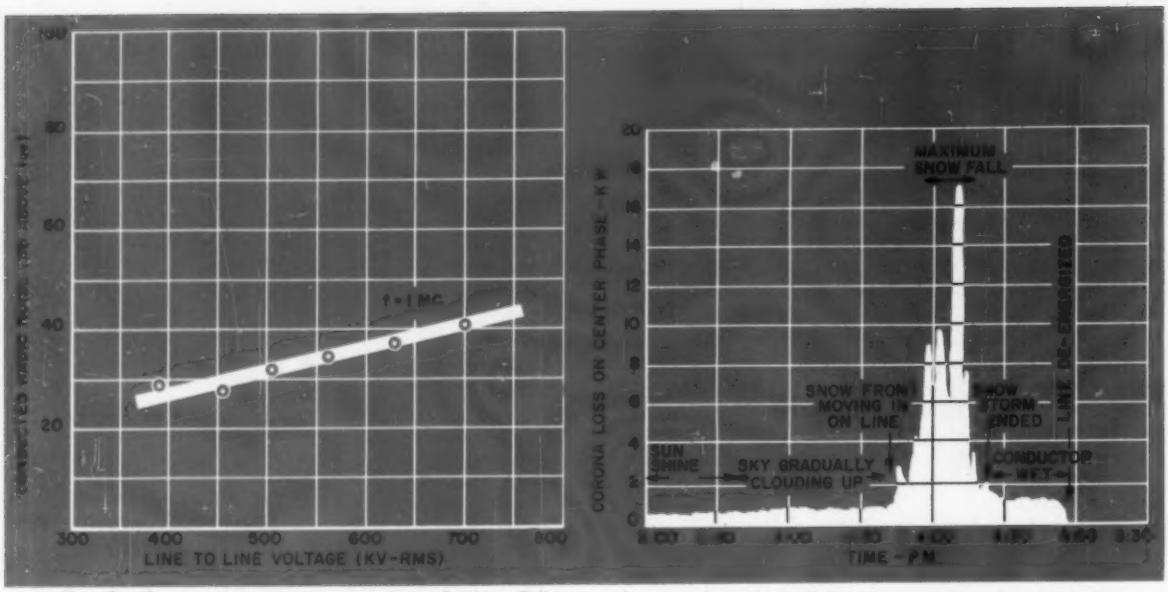


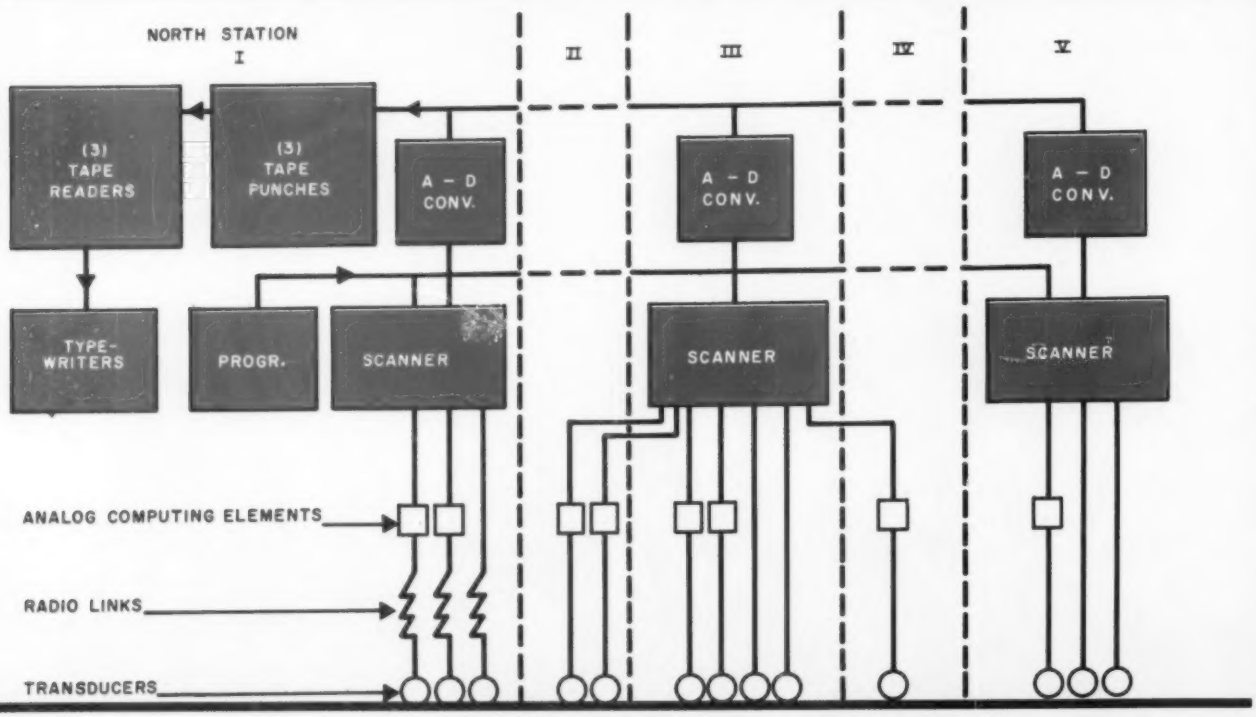
Fig. 8. Corona loss as measured on Project EHV on December 8, 1960. Fig. 9 is a graph showing the conducted radio noise measured at North Station of Project EHV, as a function of voltage

mained wet, and the losses were somewhat higher at 5 p.m. than at 3 p.m.; about 5 kw per 3-phase per mile. These, and other results obtained to date, have proved the adequacy of the Project EHV design, and it may be concluded that the objectives presented above will be attained.

Editor's note: This article concludes one of the best stories on EHV ever written. Beginning with the June issue of POWER ENGINEERING, Dr. Abetti has discussed the history, development and future of extra-high-voltage, in general. Also, he has presented an excellent picture of "Project EHV." We are proud to bring you this series of articles, presented by one of the world's foremost authorities in the field of EHV.

Dr. Abetti listed a number of reference sources in his original text. These have been omitted, for sake of brevity, but will gladly be furnished on request. END

Fig. 10. Block diagram of measurement and data-acquisition system



REPETITIVE HEAT BALANCES SAVE MAINTENANCE TIME AND DOLLARS

Dr. Stanley W. Anderson, Middle West Service Co., explains advantages of computer-run heat balances

LARGE DOLLAR SAVINGS due to Btu reduction in station net heat rate have resulted from running heat balances on a digital computer. Analysis of some 30-odd heat balances indicates that the dollar saving has varied between $0 and $15,000 per heat balance. However, the dollar saving due to Btu reduction is the smallest part of benefits accruing from the studies. Major value of repetitive heat balances is derived from the following reasons:

1. Certain turbine failures, resulting in loss of load and in higher cost generation are avoided.
2. Certain scheduled overhauls are postponed.
3. Time is saved during overhauls since it is known in advance what to expect.
4. Metering accuracy is increased.
5. All savings calculations are conservative.

Heat balances have been a valuable tool of the power engineer for many years. Many an engineer works out a heat balance when he suspects something is amiss in his boiler-turbine-condenser heat cycle. However, he does not make a large number, since it takes from 10 to 15 man-days to make a proper heat balance by hand. A further disadvantage of such a heat balance is that generally the accuracy is not what is desired; and when the heat balance is completed by hand, one has a certain amount of doubt that errors might have been made in the calculation.

We, at Middle West, have developed digital computer programs that will handle gas- or coal-fired, reheat or non-reheat turbines. They will handle about 95 per cent of all turbines larger than 15,000 kw plus a certain proportion of those smaller. We do not have one single program, but a family of programs.

Our digital computer studies are extremely accurate and very satisfactory. We can include certain calculations that were included with difficulty when we made heat balances by hand. Our heat balances are operating heat balances. They are on turbines that are operating in the field. The data that they use has generally been obtained from station instruments that have been calibrated ahead of time for accuracy. The programs take the data directly as it is obtained from the turbine and compute the heat balances under operating conditions.

We have been making this type of study for several years for a number of clients. Most of them treat the heat balances like a doctor's checkup. Instead of running a few by hand during the lifetime of a turbine, they have a heat balance made every three or four months, then compare one heat balance with the preceeding one to see what changes have taken place in the turbine. Frequently the turbine is in a satisfactory condition. However, as is more normally the case, something is amiss and it is pointed out in the heat balance.

CASE HISTORIES. We have run more than 40 heat balances on our digital computer. Many of these have been repeat runs on the same turbine. Results have been very interesting. If station instruments are used to obtain data, supposedly, they are calibrated ahead of time so that accurate results may be obtained. However, the item of difficulty we most frequently find is that station instruments are out of calibration. Of these 40-odd heat balances, ten of them had metering errors. In general, the heat balance can be computed anyway, with perhaps one calculation that is incorrect due to the metering error. Consequently, metering in the power plant is one of the first things that is improved by repeated studies.

A number of items have shown up consistently. Six of the turbines have had abnormal dummy leakage due to damaged dummy packing. Seven have had heaters not operating correctly. In addition, one turbine — a new one that had been on the line perhaps six months — had one heater that was not operating at all because of faulty installation. Four of the turbines have had an improperly operating condenser. Two of these had fouled tubes; one had very bad air leakage; one had insufficient circulating water. One turbine has had seal leakage. One turbine has had fouled boiler tubes. Certain of the turbines had several things wrong, and certain turbines had nothing wrong.

In several instances it was possible to postpone a scheduled overhaul because results from heat balance studies indicated the turbine was in relatively good shape. In certain other instances, turbine overhauls were performed sooner than planned.

HOW IT IS DONE. The turbine is tested by its own operators. It is held at one specific load point — normally full load — for two hours, and data readings are taken as required. These readings are then recorded on data sheets which are returned to Middle West. (See Fig. 1.) This data is punched on paper tape and run into the LGP-30 digital computer that is leased by Middle West. The computer calculates all relevant values, and prints results as shown in Fig. 2.

A highly skilled power engineer studies the results. He compares them with expected values in a comparison table (on page 61) and transfers results to a heat balance diagram as in Fig. 3. There he analyzes them, looking for existing

1

TEST DATA 100

Company XYZ POWER COMPANY Station Westdale Unit L

Test Date April 5, 1961 Class B & H1 Non-Reheat

	Symbol	Item	A	B
1			100	
2	T_{YQ}	Condensate Temperature °F		
3				
4				
5	H	Gas Flow Mcf/Hr.	442	
6				
7				
8	B	Heat Value of Fuel Btu/Ft3	1022	
9				
10				
11	U	Station Use Mwh/Hr.	1.680	
12	V_1		Omit	
13	P_{at}	Throttle Steam Pressure Psig	865	
14	P_{a4}	Heater "D" Extraction Pressure Psig	190	
15	P_{a3}	Heater "C" Extraction Pressure Psig	68	
16	P_a Cond	Condenser Absolute Pressure In.Hg.Abs.	1.99	
17	T_{d1}	Heater "A" Drain Temperature °F	172	
18	T_{d2}	Heater "B" Drain Temperature °F	242	
19	T_{d3}	Feed Water Temperature from Heater "C" °F	310	
20	T_{d4}	Heater "D" Drain Temperature °F	326	
21	T_{w1}	Condensate Temperature from Ejector °F	104	
22	T_{w2}	Condensate Temperature to Heater "B" °F	185	
23	T_{w3}	Condensate Temperature from Heater "B" °F	247	
24	T_{w4}	Feedwater Temperature to Heater "D" °F	310	
25	T_{x1}	Condensate Temperature from Heater "A" °F	186	
26	T_{x4}	Feedwater Temperature from Heater "D" °F	375	
27	P_{a4}	Heater "D" Extraction Pressure (see 14) Psig	190	
28	P_{a3}	Heater "C" Extraction Pressure (see 15) Psig	68	
29	P_{a2}	Heater "B" Extraction Pressure In.Hg. or Psig	17	
30	P_{a1}	Heater "A" Extraction Pressure In. Hg.	-9.3	
31	P_a Cond	Condenser Absolute Pressure (see 16) In.Hg.Abs.	1.99	
32	k_4		Omit	
33	k_5		Omit	
34	h_{a2}		Omit	
35	h_{a1}		Omit	
36	T_{at}	Throttle Steam Temperature °F	905	
37	T_{a4}	Steam Temperature to Heater "D" °F	668	
38	T_{a3}	Steam Temperature to Heater "C" °F	453	
39	T_{a2}	Steam Temperature to Heater "B" °F	302	
40	T_{a1}	Steam Temperature to Heater "A" °F	189	
41	L	Gross Generator Load Mwh/Hr.	390	
42	P_M		Omit	
43	P_L		Omit	
44	T_{c1}	Circulating Water Temperature In (Ave.) °F	70	
45	T_{c0}	Circulating Water Temperature Out (Ave.) °F	89	
46	S	Steam to Ejector M#/Hr.	Omit	
47	X	Steam Flow M#/Hr.	341	
48	X	Feed Water Flow M#/Hr.	342	
49		Condensate Flow M#/Hr.	258	
50		Drum Pressure Psig	955	
51		Feed Pump Discharge Pressure Psig	1125	
52		O_2 in Flue Gases (or CO_2) %	10.2	
53		Combustibles in Flue Gases %		
54		Air Temperature to Air Heater °F	78	
55		Air Temperature from Air Heater °F	550	
56		Flue Gas Temperature to Air Heater °F	699	
57		Flue Gas Temperature from Air Heater °F	320	
58		F.D. Fan Discharge Pressure In. H_2O	17.6	
59		I.D. Fan Suction In. H_2O		
60		Gas Fuel Supply Header Pressure Psig	24	
61		Circulating Pump Discharge Pressure Pump # Psig	21.2	
62		Circulating Pump Discharge Pressure Pump # Psig	21.0	
63		Cir. Pump Suction Pressure (1) Pump # In.Hg.-Psig		
64		Cir. Pump Suction Pressure (1) Pump # In.Hg.-Psig		
65		Water Level Below ℄ Pump Discharge (2) Ft.		
66		Were blowdowns closed?	Yes	
67		Was evaporator out of service?	Yes	

(1) At ℄ pump discharge - horizontal pumps
(2) For vertical pumps

Note: Enter test data in Column A. Do not use Column B.

2

WESTDALE UNIT #1

HEAT BALANCE
APRIL 19, 1961

3+155517'100000'-0000000'

3+195518'442000'-0000000'

1+115519'10220'-0000000'3+155520'1680'0'880000'205000'83000'1990'172000'242000'310000'326000'104000'185000'247000'310000
186000'375000'205000'83000'32000'10200'1990'1900'1200'1189800'1106000'905000'668000'453000'39000'216'490'70000'89000'600
341000'-0000000''

260401. 25554. 9670.410 1003.557 11.951 7.961 7.029 4.576 8.86(
1455.326 1356.919 1257.257 1189.799 1106.000 78.919 100.919 139.900 210.
279.899 [illegible] 215.474 270.899 153.90[illegible]

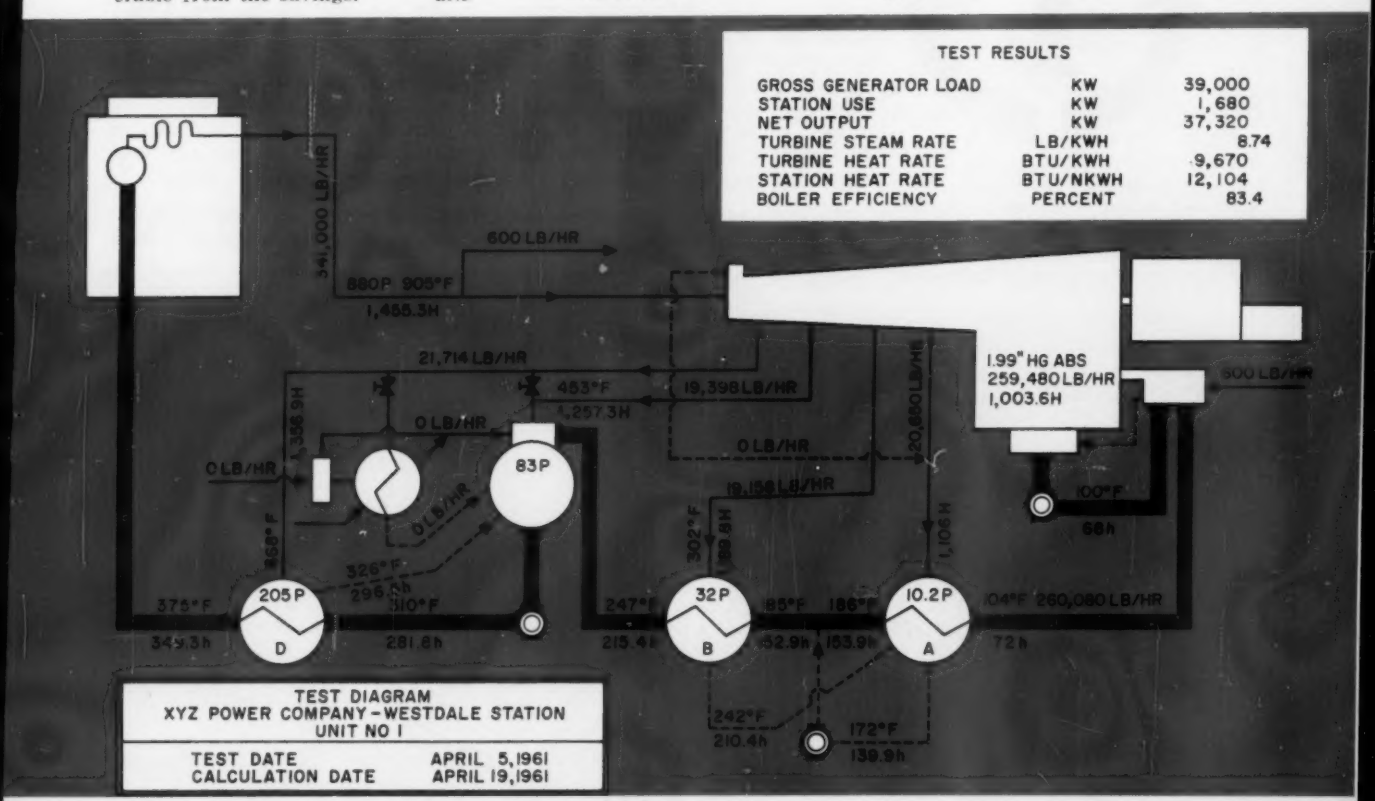
or incipient trouble, and finally makes up a report in which he makes recommendations and draws conclusions. This report is then mailed to the company that owns the turbine.

PROGRAM DETAILS. Data that are fed to the program are strictly pressures and temperatures, fuel input, Btu per unit of fuel, steam flow, loads, etc. as they come directly from the turbine test. No initial calculations need be carried out by hand. The computer takes the data and calculates required enthalpies and saturation temperatures. It then takes these enthalpies and determines the various extraction flows and other flows through the turbine-condenser-boiler heat cycle. It takes the temperatures and determines the temperature differences across the various stage heaters and across the condenser. It determines net station heat rate, gross turbine heat rate, boiler efficiency, and quantity of cooling water flowing through the condenser. Actually, the program details are essentially the same as if the heat balance were being calculated by hand.

Cost of these heat balances is very small compared to the value received and this cost is very quickly recoverable from the savings. END

Heat balance analysis, Westdale Station, Unit No. 1

		April 5, 1961	Previous Test
Gross Generator Load	Kw	39,000	38,500
Station Use	Kw	1,680	1,650
Net Output	Kw	37,320	36,850
Station Use	%	4.31	4.29
Steam Flow	#/Hr	341,000	335,600
Condensate Flow (Calculated)	#/Hr	260,080	257,179
Condensate Flow (Metered)	#/Hr	258,000	258,000
Extraction Pressure Heater "D"	Psia	205	202
Extraction Pressure Heater "C"	Psia	83	83
Extraction Pressure Heater "B"	Psia	32	32
Extraction Pressure Heater "A"	Psia	10.2	11
Extraction Flow Heater "D"	#/Hr	21,714	23,730
Extraction Flow Heater "C"	#/Hr	19,398	17,697
Extraction Flow Heater "B"	#/Hr	19,158	18,749
Extraction Flow Heater "A"	#/Hr	20,650	18,245
Enthalpy to Heater "D"	Btu/#	1,356.9	1,343
Enthalpy to Heater "C"	Btu/#	1,257.3	1,245.6
Enthalpy to Heater "B"	Btu/#	1,189.8	1,185
Enthalpy to Heater "A"	Btu/#	1,106.0	1,109
Terminal Difference Heater "D"	°F	8.9	4.6
Terminal Difference Heater "C"	°F	4.6	3.6
Terminal Difference Heater "B"	°F	7.0	5.0
Terminal Difference Heater "A"	°F	8.0	9.8
Drain Approach Heater "D"	°F	16.0	64.0
Back Pressure	In. Hg. Abs	1.99	2.64
Condensate Temperature	°F	100	113
Saturation Temperature @ Vacuum	°F	100.9	110.5
Depression	°F	0.9	+2.5
Condenser Terminal Difference	°F	11.9	11.5
Calculated Circulating Water	GPM	25,554	23,645
Turbine Steam Rate	#/Kwh	8.74	8.72
Turbine Heat Rate	Btu/Kwh	9,670	9,620
Station Heat Rate	Btu/NKwh	12,104	12,410
Boiler Efficiency	%	83.4	80.9
Total Temperature Rise Through Heaters	°F	271	263
Total Extraction	#/Hr	80,920	78,421
Extraction per °F	#/Hr	299	298



EEI T & D COMMITTEE SEEKS BETTER SERVICE FOR LESS DOLLARS

"DON'T FORGET, transmission and distribution dollars are greater than half of our electric utility plant investment, and service and price have kept us successful," A. P. Thompson, president of Iowa Power and Light Co., told the 86th meeting of the Edison Electric Institute Transmission and Distribution Committee as he welcomed the group to Des Moines in October. "Our economies come through self discipline in our work."

Evidence of self discipline came to light in discussions presented by power engineers in the general engineering, overhead, standards and specifications, safety and underground subcommittees.

UNDERGROUND. It was revealed that Commonwealth Edison Co. can build residential underground for $50 per lot (more than equivalent overhead) by sharing the trench with the telephone company. However, the real estate developer must have 24 or more lots and meet specific requirements. Martell F. Tuntland of C. E. showed how the joint trenching system evolved at Hasbrook Subdivision, Arlington Heights, Ill. There, the No. 4 copper 12-kv primary was installed at the bottom of a 36-in. deep trench which was backfilled 12 in. to accommodate the telephone cable. Almost 2000 trench ft of cable and necessary pedestals have been placed in one work day.

Secondary has been copper or aluminum ribbon cable of various sizes. Commonwealth plans to use this design with 2/0, 3/0 and 4/0 aluminum conductors, also for common-trench installation. In October, Edison received State Commission approval to install, own and maintain service connections to the customer's meter on new underground systems for one dollar per linear ft.

This desire for the utility to maintain service all the way to the customer's meter was also reflected in a discussion by H. G. Hally, Iowa Power and Light Co. He discussed his system where 7620-v primary is brought underground to a Utilization Transformer at a high-use customer's residence. Like the "little black box" concept of power for each home, the scheme does not offer the advantages of diversity and does increase transformer capitalization. However, these items are "more than offset by a saving in secondary losses and wiring costs, plus vastly improved voltage regulation," said Mr. Hally.

His company's experience with residential demands (includes all-electric homes) indicates that few will exceed 30 kva, and most will be 20 kva or less. With recent improvements in transformer insulation and lower transformer impedances, "we could, if necessary load the Utilization Transformer to 300 per cent of nameplate rating for short peaks, without causing excessive voltage drop or unduly shortening the life of the unit," Mr. Hally said.

ALUMINUM INSULATED CABLE does the job for which it is intended—if corrosive moisture can be kept out of it, was the idea behind three papers presented. "All failures of

"Safety injections" were given by (l-r) W. C. Bremner, Commonwealth Ed., B. J. Lorenz, NIPSCO, and G. R. Guthrie, Indianapolis Power and Light

aluminum cable have been on the low voltage circuits and were caused by moisture attacking the conductor," said Howard L. Davis, Jr., Philadelphia Electric Co. "It must be recognized that aluminum cable has to be manufactured, installed, handled and operated with an entirely different philosophy than its copper equivalent." He stressed that greatest of care be used in handling to prevent any damage to the covering which may allow moisture entrance.

L. L. Carter, Anaconda Wire and Cable Co., discussed failures on 5- and 15-kv insulated aluminum cable. "The incidence of such corrosion has been such that we cannot justify recommending insulated aluminum at any voltage for underground service unless a sealed metallic sheath is used as an outer covering. Neither do we recommend the aerial installation of insulated aluminum at the higher voltages until the combined work of the producers and field experience of the users demonstrate clearly that their constructions are reliable," he said. "At this time it is believed that the only solution is complete strand filling to block out moisture and air."

After demonstrating, by chemical formula, the corrosion process due to moisture, H. L. Spaulding, who presented a paper co-authored by W. K. Priestly, both of Kaiser Aluminum and Chemical Corp., revealed that his company's development work is practically complete on conductors containing a chemical corrosion inhibitor which makes noncorrosive any water which may enter the conductor. The inhibitor polarizes the anode reaction by maintaining the air-formed oxide film originally present on the aluminum.

A TWO-PRONGED APPROACH trend to undergraduate engineering education was indicated by G. R. Town, Dean, College of Engineering, Iowa State University. "The pendulum has swung a little too far to make everybody more scientific. I feel we will have more bifurcation in undergraduate engineering education," he said. However, he said today's engineering student must follow today's science. Consequently, outmoded technical courses are being dropped to make a place for more applied science and mathematics. Some schools are abolishing departments (EE, CE, etc.) to educate just engineers. Others are appraising the the problem by setting up departments like a power department where all those interested in steam, gas, nuclear, electrical and aerospace subjects would specialize. Dean Town recognized that provisions are definitely being made for those who must know engineering which is not highly mathematical.

Thomas C. Duncan, Consolidated Edison, T & D Committee chairman, summed it up well for the utility industry: "We need a few 'long hairs,' but our greatest need is for practical engineering people who can do lots of things."

AERIAL BASKETS, like any other tool used in the utility industry, have certain inherent hazards connected with their operation and use. "The very selling points that make the equipment so desirable in operations —mobility, ease of reaching elevated locations, insulation value, reduction of necessary protective equipment, reduction of necessary personnel to do a job—have a tendency to undermine or minimize the safe practices which we have been developing for years," warned B. J. Lorenz, Northern Indiana Public Service Co.

He urged "belting in" the men in the basket. (Too many have already fallen because they weren't belted in.) NIPSCO uses a nylon lanyard with D-ring located in the back of the belt. It allows free movement within the basket, but does not let the employee stand on the basket rim. Lanyard and belt shock load rating is four times that of the standard lineman's body belt and safety strap. Should the basket tip, the lineman's free fall would be but a foot or so. With the D-ring at back, any fall shock would be taken by the stomach muscles rather than the back muscles.

SPLICES DO FAIL, and Richard Neal, Dayton Power and Light (presenting a paper by W. J. McLain), told what his company learned about splices and what they now recommend. Inspection of a corroded tension splice which failed under abnormal conductor loading conditions revealed that moisture had crept in due to improper sealing. Other splice inspections revealed inhibitor compound present as an insulation in the portion of the sleeve that had been indented by the conductor strand. The compound was hard and had not been extruded out of the high-pressure contact area, giving the splice a high resistance. This led to a testing program on critically loaded lines—417 splices checked in all.

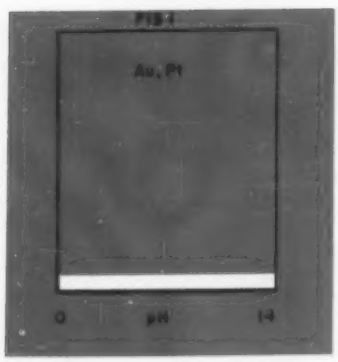
Presently, DP&L is laying back the layers of a splice on old wire, wire-brushing them and applying compound as the strands are laid back in place. The company believes the sealing compound must have a high melting point (well above the conductor damage temperature) so that it will stay in place. Only on jumper or loop splices are poor splices recompressed.

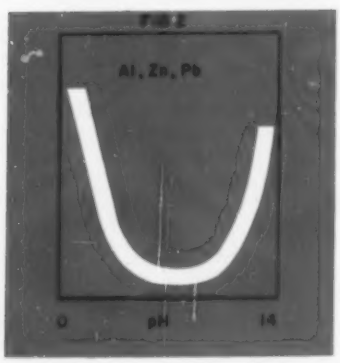
"We think it is good to run periodic checks on splices in critical lines, for splices can deteriorate. The infrared pyrometer (bolometer) is a good device for making these checks and we have purchased one," Mr. Neal said. The thermistor sensing device in the pyrometer should be small as practical to minimize sky effects, he recommended. END

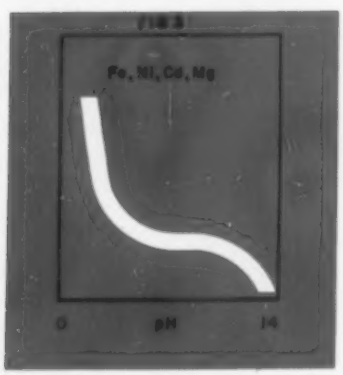
T & D Committee Chmn. T. C. Duncan (center), Consolidated Edison with Dean G. R. Town (r), Iowa State and H. G. Hally, Iowa Power and Light

MAJOR FACTORS IN CORROSION

Last of three articles by Earle M. Sommerfield of United Engineers and Constructors







CORROSION PROCESS depends on a large number of factors which do not act independently of each other. Instead, there is a complex mutual interaction of the factors. The factors can be divided into two large groups — external and internal. First, the external factors:

Consider the case where the solution itself is not an oxidizer, and contains only the oxygen of the air, which is almost always unavoidable. Various results emerge depending upon the metal involved as shown by Figs. 1, 2 and 3 (for non-oxidizing solutions only).

Referring to Fig. 1 for gold and platinum, as is to be expected with such noble metals, the rate of corrosion is very low, showing practically no dependence on the pH of the solution.

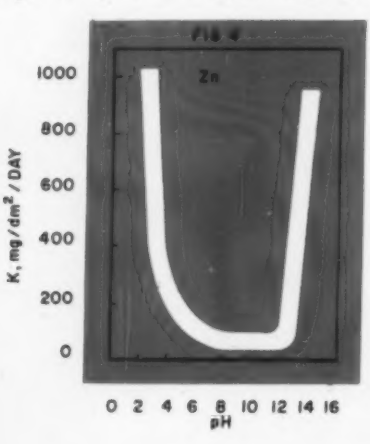
Referring to Fig. 2, a considerable change in performance is noted for aluminum, zinc and lead. Here there is a sharp increase in the corrosion rate for both acidic and basic solutions. This curve is a general curve for these three metals.

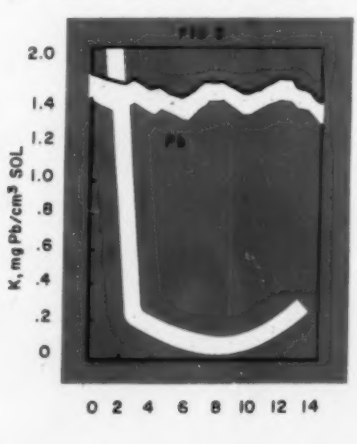
Specific curves for zinc and lead are shown in Figs. 4 and 5 respectively. The protective oxide films formed are soluble in both acid and alkaline solutions, which explains the rapid increase in corrosion rate as pH changes. Aluminum is more resistant to acid than to alkali.

Referring to Fig. 3 for iron, nickel, etc., another change in performance is noted on the basic end of the pH range. These metals form protective films which are not soluble in the alkaline range, which explains the reduction of corrosion rate in the alkaline range.

Where the solution itself has oxidizing properties, such as nitric and sulfuric acid, the dependence of the rate of corrosion on pH is more complicated.

Figs. 1, 2, 3, 4, 5 show corrosion vs. pH (all non-oxidizing solutions)





CORROSION INHIBITORS IN SOLUTION. There are three types of inhibitors, as follows: 1. anodic, 2. cathodic, and 3. organic colloids. The anodic are so called because they inhibit by reducing the anodic area of the galvanic couple. Anodic inhibitors consist of: 1. oxygen, 2. sodium bicarbonate, and 3. chromates.

Oxygen in solution can both stimulate and inhibit corrosion depending upon the conditions existing. At the same time, oxygen increases the stability of the protective film on many metals. The higher the oxygen content, the greater the probability of the formation of protective films. Therefore, a sufficiently high oxygen content is necessary for it to act as an inhibitor. At contents of oxygen below this point, it will act as a corrosion stimulant. We can also say that the action of oxygen as a corrosion stimulant is more pronounced the lower the pH.

In basic solutions, the inhibitive properties of oxygen for such metals as Fe and Ni are very pronounced and even a small amount of oxygen is often sufficient to stop the corrosion process completely.

Copper, in contrast to iron, has a fairly high chemical stability. At the same time, the protective films on copper are not formed easily under the action of oxygen and they do not have the high protective qualities of those of iron. Therefore, for metals such as copper, oxygen is *mainly* a stimulant, and *not* an inhibitor. We might note in passing that aluminum is similar to iron in this respect.

Oxygen is not the only substance acting as an inhibitor and at the same time as a stimulant. In the case of iron corrosion, the influence of the additions of sodium bicarbonate ($NaHCo_3$) and of acid sodium phosphate (Na_2PO_4) are similar to that of oxygen in that they lower the probability of corrosion but accelerate it in spots where it has begun. (Partial action reduces area of anode, which increases rate.) Both the probability and the rate of corrosion can be reduced to zero by raising the concentration of these compounds to a certain level. So keep in mind that an insufficient quantity does more harm than none at all.

Chromates of the alkali metals ($K_2Cr_2O_7$ and $Na_2Cr_2O_7$) efficiently reduce the rate of corrosion, and are spoken of as universal passivators, but they are only universal under certain conditions. The introduction of small amounts into a neutral solution is sufficient to stop corrosion completely. The amount for iron, zinc and copper is of the order of 1/100th to 1/10th of one per cent. It depends greatly, however, on the presence of other substances in the solution that activate corrosion, particularly *chlorides*, which are present in many cases.

Caution: with an increase in hydrogen ion concentration, the inhibiting action of the chromate decreases, and in a sufficiently acid solution, chromates may considerably increase corrosion because, being oxidizers, they also strongly depolarize. Thus, only in *neutral, basic or very weak acid solutions* can chromates be utilized as inhibitors.

Cathodic inhibitors are so called because they lower the corrosion rate by reducing the cathodic area of the galvanic couple (accomplished by formation of insoluble compounds which weaken the action of the cathode). Cathodic inhibitors consist of: 1. Ca $(HCO_3)_2$, 2. Zn SO_4, 3. some nickel compounds, 4. a number of Mg compounds. These belong to a class of safe inhibitors (there is always a reduction in corrosion).

Organic colloid inhibitors are efficient mainly in acid solutions. They consist of: 1. gelatine, 2. agar-agar (seaweed derivative), 3. sulfonated glue, 4. derivatives of quinoline (quinine and potash), 5. many alkaloids (quinine, morphine). They are usually required only in small amounts of 1/100 to 1/10th of one per cent.

ACTION OF STIMULANTS IN SOLUTIONS. Assume a condition where *ferric* salts are in solution where iron is corroding. These *ferric* salts are good depolarizers because they can change into a ferrous form and consequently will accelerate corrosion. Because the solution is in contact with air, additional oxygen will enter into solution. The *ferrous* salts that are formed as a result of the depolarization will again become *ferric* salts under the action of the dissolved oxygen. The ferric salt produced will again be reduced to the ferrous form at the cathode, then again oxidized, etc. Among the complex-forming stimulants are the cyanides, which, *in the presence of oxygen,* greatly accelerate the destruction of even such metals as silver and gold.

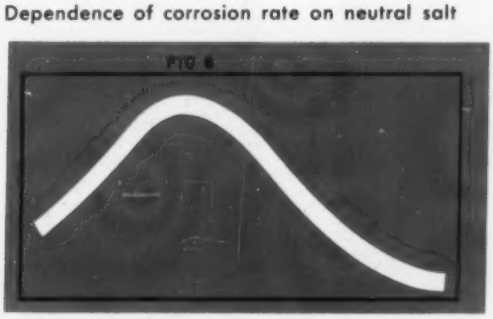
Ammonium compounds and ammonium solutions are extremely harmful for copper, *in the presence of oxygen.*

Sulfides of cu-iron have very low protective qualities, and as a rule, when sulfides are formed the corrosion of copper and iron is accelerated.

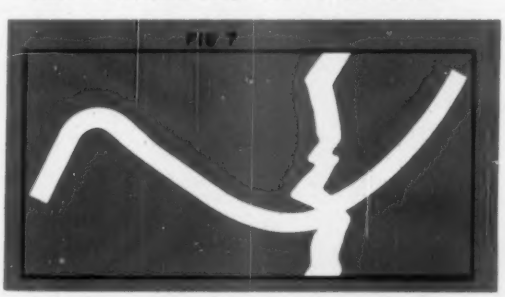
CONCENTRATION OF NEUTRAL SALTS. Exact measurements have demonstrated that in *many* cases the dependence of the corrosion rate upon the concentration of a neutral salt is represented by a curve having a maximum (Fig. 6). The maximum is located at different values for different metals and salts. The ascending branch of the curve is connected with an increase in the electro-conductivity of the solution with the increase of concentration. (Magnitude of corrosion current increases.)

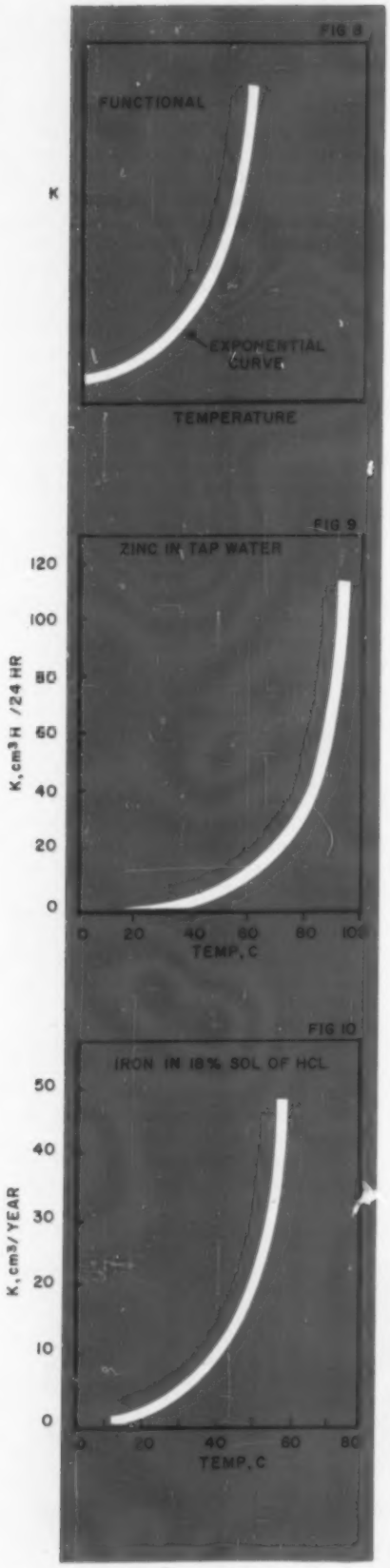
Moreover, we know that the increase of concentration of anions

Dependence of corrosion rate on neutral salt



Rate of solution may result in cavitation





such as Cl^-, SO_4^{--}, reduces the protective properties of the films and thus enhances the corrosion rate. However, also with the increase of concentration the solubility of oxygen drops, and with it the rate of depolarization drops and the corrosion rate therefore decreases. This explains the curve's maximum.

Descending branch of the curve indicates that concentrations have been reached where the influence of O_2 deficiency prevails over the increase of electrical conductivity and the lowering of the protective quality of the films.

RATE OF SOLUTION MOVEMENT. This matter is quite complex since increase of velocity often leads to changes of other factors. Initial increase of corrosion rate is due to increase of oxygen supply as velocity increases, since depolarization is increased. The subsequent decrease may be due to passivation since the oxygen supply is increased to a point where its inhibiting effects are greater than its stimulating effects.

In the final increase, the velocity is getting into the so-called impingement corrosion zone where velocity is so high that protective films are torn off. An example is corrosion of brass condenser tubes where the velocity is too high. Continued increase in velocity may result in cavitation. (Figure 7.)

INFLUENCE OF TEMPERATURE. As with any other chemical process, rate of corrosion increases with rising temperature, as represented by the exponential curve, Fig. 8. The dependence of zinc in tap water and iron in acid upon temperature belongs to this type. However, in a number of cases, the change of temperature modifies the influence of other corrosion process factors.

For instance, when corrosion proceeds with oxygen depolarization, it must be considered that the increase in temperature acts in two different ways; as we have seen, increase in temperature accelerates the action but at the same time the increase in temperature decreases the solubility of oxygen from the air. When oxygen can evolve from the system with increasing temperature, as in an open system, a curve with a maximum is obtained (Fig. 12). The decline is explained by the oxygen deficiency in the solution. When oxygen cannot escape from the solution, the corrosion rate increases with temperature.

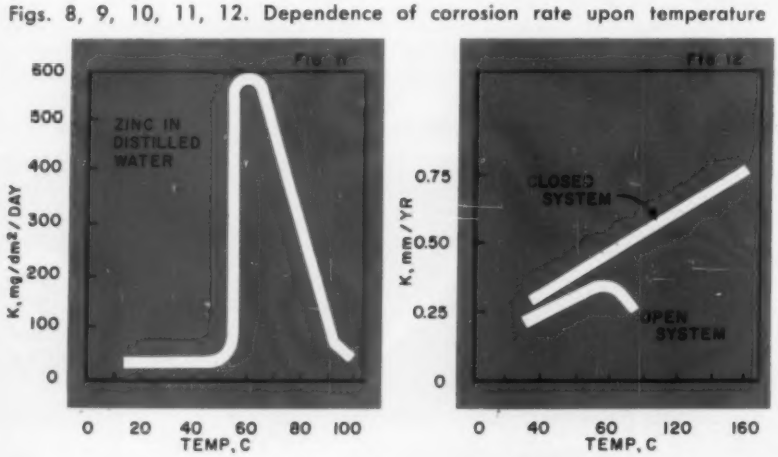
Finally, in evaluating the influence of temperature on corrosion, the properties of the protective film should also be considered. If they are temperature dependent, the change in corrosion rate can often be attributed to this dependence. An experiment with zinc corrosion in distilled water is very instructive.

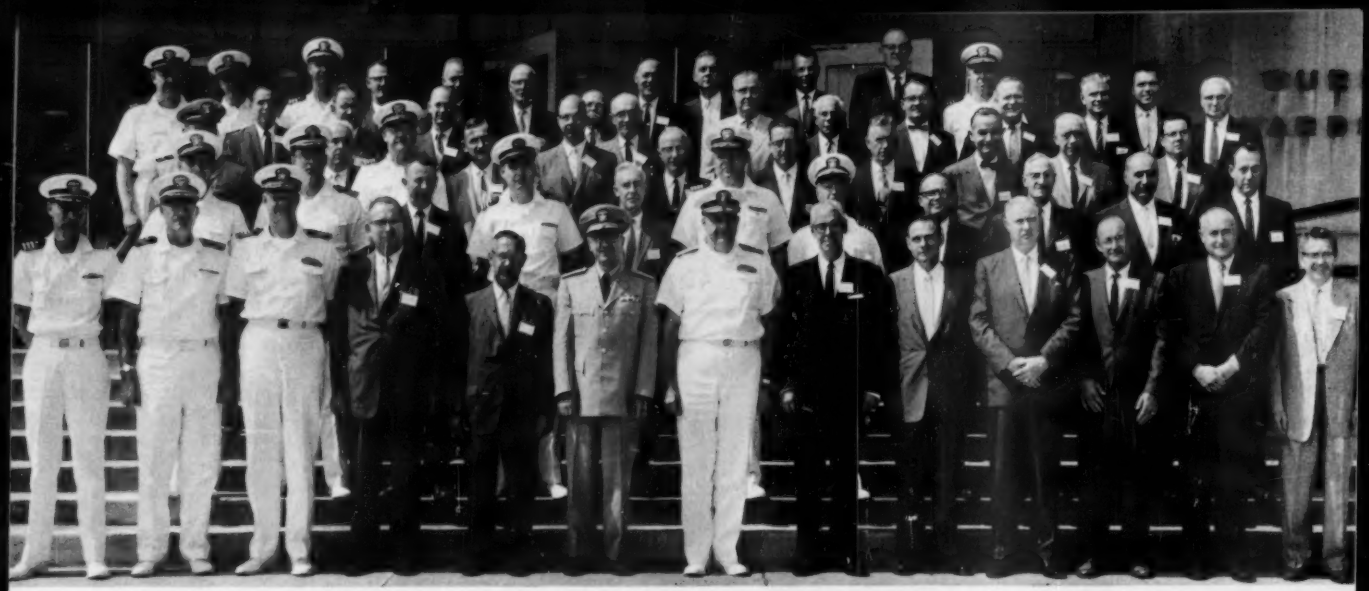
The diagram (Fig. 11) shows that with an increase of temperature from 50 C up, the rate of corrosion first increases, reaches a maximum and then drops abruptly almost to zero. In the temperature interval 50-95 C the film has weak protective qualities. At temperatures above and below this range, the film has high protective qualities.

INTERNAL FACTORS influencing corrosion are: 1. internal stresses and deformations, 2. corrosion fatigue, 3. surface condition, 4. grain size. We have discussed all of these except grain size, which in general affects corrosion very little. END

Figures from G. V. Akimov, Factors Involving Corrosion, from *Corrosion*, Sept. 1959

Figs. 8, 9, 10, 11, 12. Dependence of corrosion rate upon temperature





BUDOCKS—Industry group attending utilities workshop. RAdm. E. J. Peltier (front row center) is flanked by RAdm. P. Corradi and Editor Bob McCaw. Cmdr. A. W. Walton, BUDOCKS' Utilities Chief, is in back row at the far right

NAVY AND INDUSTRY COMPARE NOTES ON UTILITIES MANAGEMENT

CONTRARY TO general opinion, our Navy is not composed entirely of ships, subs, planes and similar floating facilities. To support all such units on the high seas requires a fantastic amount of shore-based units and equipment. Shipyards, air stations, ammunition and fuel "dumps," communications centers, housing, transportation and many other facilities are some of the *support* elements of the Navy.

Construction and maintenance of these facilities is the responsibility of the Bureau of Yards and Docks —one segment of the total Naval complex — commonly known as BUDOCKS. And, in addition to construction and maintenance functions, this division of the Navy is charged with the operation of certain facilities. Utilities, such as electric, water, gas, compressed air and sewage disposal, are part of this responsibility.

BUDOCKS, under the capable leadership of Rear Admiral E. J. Peltier and his staff, has established operating and maintenance procedures for Navy's utilities systems, which are in keeping with today's most modern concept of management.

To check on their performance—by a comparison with private enterprise — BUDOCKS recently conducted a Utilities Workshop, and invited a number of utility and industrial power engineers to participate. Purpose of the meeting was to compare BUDOCK's objectives (and performance) with those of private industry.

Some months ago, a private management-consulting firm (Booz-Allen and Hamilton) was employed to make a study of BUDOCK's utility management. To implement this survey, a checkup with private industry was deemed advisable; hence this particular workshop session.

Representatives of industry, utilities, Army, Navy and Air Force—numbering about 60 persons—attended the meeting. Concurrent workshop sessions were held in which these subjects were discussed: Utilities Systems, Operations and Distribution, Inspection and Maintenance, Usage Control, Programs and Capacity to Perform, Management Surveys and Assistance, and Management Reports. Definite objectives were assigned to each group, and answers to specific problems were sought.

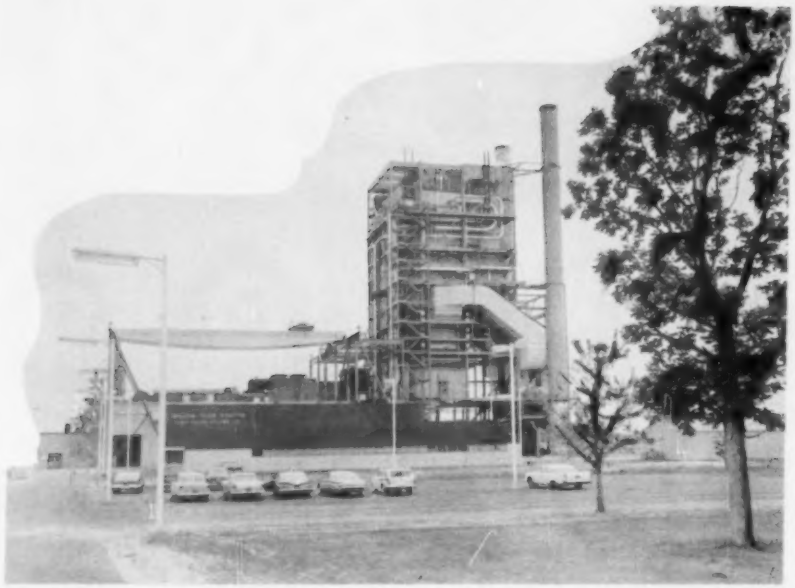
After the independent workshops had finished their meetings, a summary conference reviewed all conclusions. Since no preliminary guide-lines had been set for the session, all conclusions were those of the independent groups of BUDOCKS—Industry people.

AN EFFICIENT OPERATION. By comparison with private industry's highly-efficient utilities operating standards, it is most gratifying to find that BUDOCKS is doing an extremely capable job of operating a huge utilities complex. (Currently, their plant investment is $1 billion, maintenance and operating expense is $200 million, and they operate some 750,000 kw of generating capacity.)

Typical of the Bureau's very modern utilities-management concept is the use of network analyzers for long-range studies of electrical distribution systems. With this technique, BUDOCK's electrical engineers can save thousands of dollars by doing intelligent planning of distribution alterations and expansions.

Commander A. W. Walton is Chief of the Utilities division of BUDOCKS; he conducted the workshop in a most effective manner, and did an excellent job of "picking the brains" of all the conferees. Public works officers, and civilian utilities power engineers, from most of the Navy's district offices, participated in this meeting.

As a taxpayer, and unbiased observer, it appears that BUDOCKS is doing a top-flight job of running a very big — and complex — utilities operation. Most of the best management techniques employed by private industry are being employed by this division of our Navy. BUDOCKS is to be highly commended for "baring their souls" to experts from private industry — and asking for frank criticism. Happily, for the American economy, their Utilities division was not found to be lacking in any major concepts. END



FIVE TELEVISION EYES IMPROVE STATION ECONOMICS AND SAFETY

J. O. Robichau, engineer, Gulf States Utilities Co., shows how closed-circuit TV helps station operation

CLOSED-CIRCUIT TV has greatly aided in meeting the design premise of Gulf States' new Willow Glen Power Station. The central control room operator has full remote manual control of the 150-Mw unit and will ultimately have the additional controls of a 220-Mw unit. Also, this operator is responsible for plant security when the station office is normally closed.

Recognizing the necessary and sufficiently desirable visual communication requirements to enable this type of operation, power engineers incorporated five independent closed-circuit TV systems in the plant design:

1. Furnace Monitoring.
2. Drum Water-Level Monitoring.
3. Plant Surveillance.
4. Screen Well Surveillance.
5. Gate Supervisory.

These systems adequately serve the intended purposes, and they have enhanced the safety and economics of operation.

The central control room design of the newer plants on the Gulf States System has incorporated many new approaches, commensurate with reliability and reasonable cost, to economize its production operation. While inclusion of TV at Willow Glen is not new, the extent of its application is unique there.

Twenty-two systems have been installed in the company's five power plants with additional TV systems being planned for future units. During ignition and operation of the 1,100,000 lb/hr tangentially gas-fired, positive-pressure steam generator, two TV systems provide the necessary visual supervision of the furnace and the drum water level. As shown in Fig. 1, the two 10-in. monitors occupy prominent positions on the boiler-turbine-generator gage board.

This equipment has given a greater feeling of confidence and security to operating personnel by furnishing some visual feedback in response to certain control changes. Particularly is this true of the furnace system which enables observation of stable ignition and operating flame patterns. With experience, operators can associate these patterns with such changes as air and burner tilt. Much reliance is placed on this system during remote light-off.

Besides the drum water-level monitor, two other indications of level are available in the control room. In addition, a large gage is in easy view of the operator.

The furnace camera equipment is mounted near the furnace roof and views downward through a special opening in the boiler tubes. Because of the recess in the front furnace wall, it was not necessary to provide a weatherproof housing for the camera. However, it is now apparent that some provision should be made to force air circulation within the recessed area to improve ambient temperature conditions. We propose merely to vent an air stream from the window cooling air system to create turbulence within the recess.

Cooling air requirements are furnished by a motor-driven blower

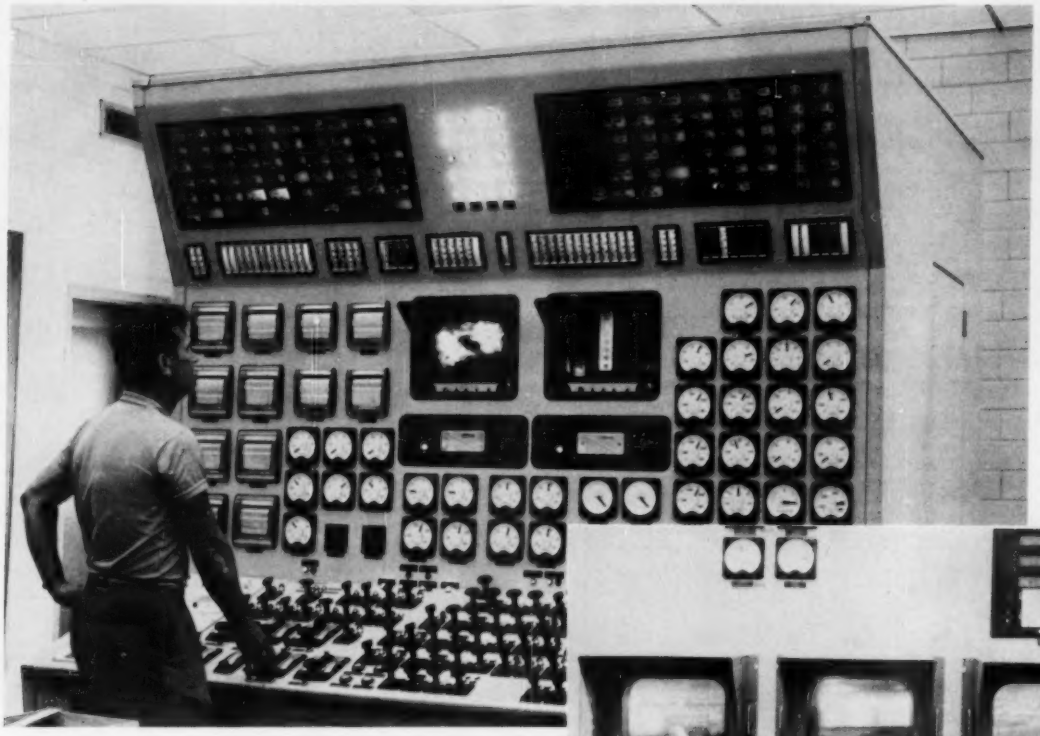


Fig. 1 (above). Control Operation Foreman A. B. Cross at boiler-turbine-generator gage board watches furnace and drum level monitors

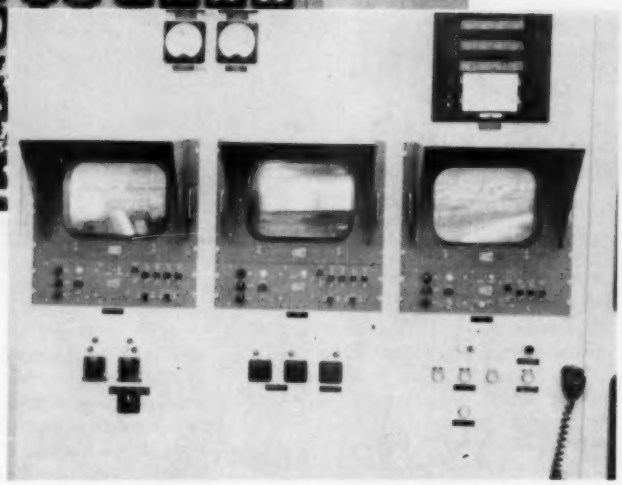


Fig. 2. Plant and screen-well surveillance and gate supervisory monitors on auxiliary board

which supplies 250 cfm of air at 25 in. of water. Should this system fail, automatic transfer is made to the station service air system.

PLANT SURVEILLANCE. These two systems are new applications to Gulf States power plants as they serve to enable the operator, who must be ever present in the control room, to personally observe very remote equipment and major facilities on the station property.

Each camera is equipped with pan and tilt mechanisms with ranges of 355 degrees and 45 degrees, respectively. In addition, each camera is equipped with turret lens.

With the plant surveillance camera installed at 68-ft elevation on the outdoor station, the operator can view the remote water-treating building, office and shops building, gas regulator station, tank storage area, and the parking lot. Also, he can view the turbine-generator area, main transformer, and a portion of the boiler structure.

The camera for screen-well surveillance is installed on the screen well structure itself, which is located on the batture of the Mississippi River approximately 1000 ft from the plant. Of primary viewing interest are the circulating-water pumps, the traveling screen, and their associated equipment on this platform. Also, this system serves to inspect the intake trash rack and floating deflector at the river, some 1600 ft from the plant. The operator can obtain different views of other remote facilities normally monitored with the plant surveillance system.

The two 10-in. monitors and camera control units are mounted on the auxiliary boards in the control room (Fig. 2) along with the gate supervision system monitor.

GATE SUPERVISORY. The personnel and automotive gates can be controlled from the office or control room, and a 10-in. monitor is installed in each location. The system furnishes a general view of the entrance road and gate area for determining when entrance or exit is completed.

It was not intended that this TV system afford positive personnel identification. For identification purposes, a person at the gate can communicate with the office secretary during regular hours, or the control room when the office is closed, by means of the plant intercom.

The gate camera employs a single lens. Previous attempts to utilize a zoom lens in gate applications have not indicated a sufficient justification for continued use. Also, sun protection other than that provided by the outdoor housings was not provided for the systems. END

NAVY TEAMWORK MOVES TURBINE-GENERATOR TO TROPICS

Capt. P. W. Roberts BUDOCKS, USN, describes how island power shortage was averted

GUAM faced a growing power shortage in 1959. To meet the imminent demand it was decided to move in components of a mobile power train then available at the Puget Sound Naval Shipyard, Bremerton, Wash.

Indications were that no ship could be made available for unloading the excessive weights of the cars, and no lifting gear was available on Guam to make these lifts. The main turbine car originally weighed 238 long tons. Therefore studies embraced several ideas for moving the cars in various types of landing craft from Bremerton to Guam. The Civil and Structural Division of PWC (Public Works Center), Guam's Design Department, made preliminary feasibility studies of plans which included off-loading the cars at Drydock Island, 2½ miles from the generating plant, and building a railroad to the Piti site. Also extensive soundings of the Piti Channel were performed by the Civil Division of the Design Department with the view of possible movement of landing craft directly into the generating plant site.

Later it was determined that the *USNS Pvt. Leonard C. Brostrom*, of the Military Sea Transportation Service, could be made available for transporting the cars. This ship had a lifting gear capable of off-loading the turbine car and switchgear car to the extent of 140 tons. It was determined that the turbine car could be stripped down and, by cutting eight feet ten inches off the car to enable it to fit into the ship's hold, the weight of the car was reduced to the 140-ton capacity of the ship's gear.

In addition to the main turbine car, other generating equipment in the shipment aboard the *USNS Brostrom* included a 158,300-pound electric switching station, also housed in a railroad car, and the contents of a third car which were disassembled and shipped by carton. Entire weight of the shipment to

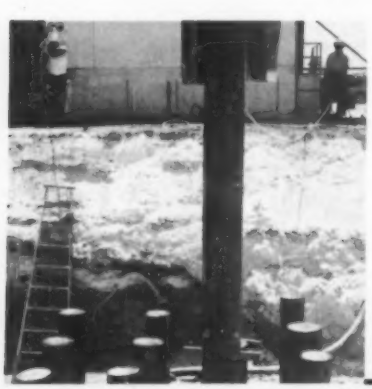


Fig. 1 (top). USNS BROSTROM listed sharply as 130-ton turbine car was being off-loaded onto the two lo-boys.
Fig. 2. Before reinforced concrete foundations were formed, these 45-ft wood pilings were driven to a depth of 32 ft

Fig. 3. Cars were raised from lo-boys, lowered onto foundations by using cribbing and air jacks

Fig. 4. Cars were lowered from cribbing onto the steel pedestals, bolted and welded to foundations

Guam was 351 tons. The main turbine car, stripped to 130 tons, was the heaviest lift ever attempted by an American flagship using its own equipment, according to statement made at the 13th Naval District Headquarters at Seattle. The *Brostrom* is said to be the only American flagship in the Pacific capable of making such a lift without assistance from dockside cranes.

FINAL PREPARATIONS. Prior to the car's arrival, the PWC Engineering Department, with the assistance of DirPacDocks representatives, had essentially finalized the installation drawings. From these, material take-off lists had been prepared and materials had been ordered. Inasmuch as the majority of items needed were not available on Guam, considerable stateside procurement was necessary.

The Supply Officer kept close account of the status of each item. High priority used on all material requisitions was justified through appropriate authorities on the basis of the urgent need for additional islandwide power. Realistic DMR's (Delivery of Material Required) were put on all stubs on the basis of the preplanned construction schedule established by the Utilities and Maintenance Departments.

Shipment arrived at Guam on 27 April 1960, and movement of the equipment to the Navy-operated Piti Steam Electric Generating Plant was accomplished by Guam's Naval Supply Depot. Surveys were performed to insure that no obstructions or interference would develop in moving the cars along approximately three miles of highway from the wharf to their destination. A new road from the highway into the plant was developed with very high bearing capacities to withstand the heavy loads imposed. Special foundations for the cars were prepared, using reinforced concrete over fourteen 45-ft wood pilings. One slab measured 9 by 12 by 8½ ft and another, 12 by 12 by 8½ ft.

Naval Supply Depot's two most powerful lo-boys, one 85-ton and one of 50-ton capacity, were spliced together end to end by steel angle irons especially fabricated for the job. Driver of the lo-boy in the rear was required to operate the vehicle in reverse gear for the entire three-mile distance, traveling at the rate of about two miles per hour. The vehicles were accompanied by men walking alongside to give exact directions to the drivers, two excellent Guamanian operators, at curves and turns to prevent the load's tipping. The movement was accomplished without incident. Two of these trips were required, one for each car.

On arrival at the Piti plant the lo-boys were stopped when the car was directly above its permanent foundation. By the use of cribbing and hydraulic jacks, the car was then gradually raised clear of the lo-boys, their angle iron connections were severed, and the lo-boys were driven away. Again by the use of cribbing and jacks, the car was lowered onto steel pedestals welded and bolted to the reinforced concrete foundation. The operation was carried out under close engineering supervision.

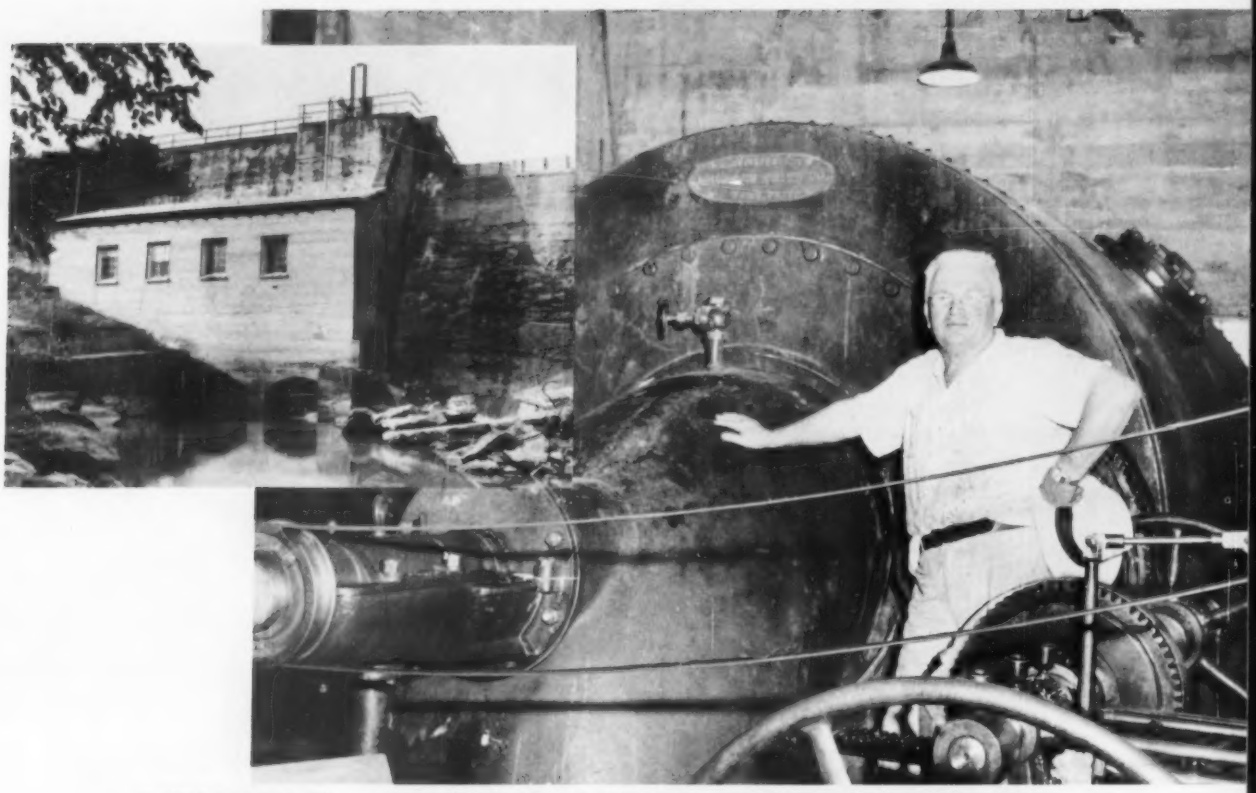
After placement of the cars and uncrating of the many supplementary parts had been completed, the reassembly and tie-in to existing facilities was begun. Connection to the main steam plant boilers required the use of eight-inch-diameter high carbon, high moly steel pipe. Bending of the expansion loops was performed by the Ship Repair Facility with new equipment recently received.

X-RAY WELDING. Welding of this piping was extremely difficult due to the composition of the metal and the high degree of perfection required. As the line was designed to operate at the temperature of 825 F and a pressure of 625 psi, it was necessary to X-ray all welds and stress-relieve them. Qualified personnel were not available on Guam to do this work, so assistance was requested from the Pearl Harbor Naval Shipyard. The Shipyard provided three welders, a stress-relieving specialist and a technician for checking radiographs taken of the welds, with the necessary equipment for their work. Facilities of the Naval Dispensary were utilized to develop the X-ray films of the welds.

Turbine overhaul and reassembly were performed by Utilities Department personnel, with the assistance of the Ship Repair Facility and under the supervision and guidance of a General Electric Company engineer at the site. Engineering services were contracted for the Bureau of Yards and Docks through the Director, Northwest and Alaskan Division, to insure the proper installation and tie-in of all equipment.

Newly installed equipment raises the net assured generating capacity of the Piti plant from 24,000 kw to 35,000 kw. Plant, operated by the U.S. Navy Public Works Center, is Guam's main power source.

When the turbine unit was officially commissioned here on 10 October 1960, the event marked the culmination of months of careful planning and close cooperation by a widespread representation of Navy, military and civilian personnel. END



HYDRO PLANT AND OPERATOR RETIRE TOGETHER

Renzy Richardson has been the one-man operator of little Eury Plant for 45 years — its entire life

AN ELECTRIC POWER VETERAN and the plant he helped build 48 years ago are retiring from service with Carolina Power & Light Co. of Raleigh, North Carolina.

In 1913, an unemployed coal miner named Renzy Richardson came upon a site on the Little River where the Eury hydroelectric plant was being built. He wangled a job as crane operator and two years later when the plant went into service he became its one-man operational force. He held the remote post from then until his retirement this summer.

The Eury plant with its 750-hp generator is being retired, too, after several years of part-time operation as a peaking facility for CP&L. Property including the powerhouse and dam, a dwelling house and the storage lake of 560 acre-feet has been put up for sale.

Eury is the survivor of several early hydroelectric developments along the Little River. It was built by the Smitherman Power Co. to supply power for mills in nearby Troy. It was acquired by CP&L and brought into the company's interconnected power system in 1926.

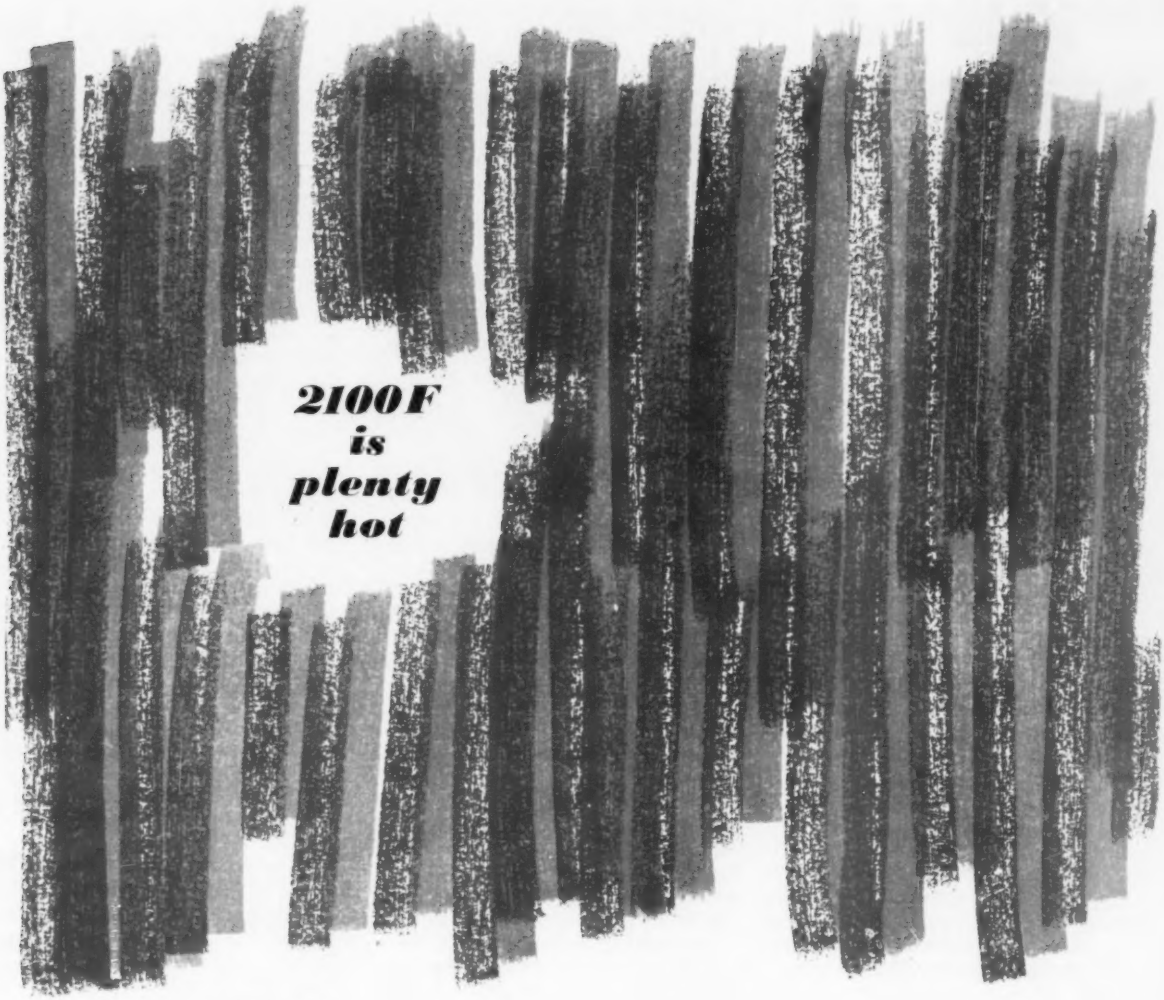
The plant and its operator have gone through harrowing times. Floods and freezes have threatened the plant. Richardson himself has the dubious distinction of being the only CP&L plant operator to go over his own dam. In 1952, while trying to dislodge a log at the crest of the dam, he lost his balance and slid 48 feet down the face of the dam to the tailrace below. He was seriously injured but recovered and returned to the job.

ELECTRIFYING EXPERIENCES. "My worst experience with electricity occurred one day when lightning jammed the main switch," Richardson says. "Fire was dancing all over the generator and the only way to stop it was to pull the switch. I put on rubber gloves and grabbed hold of the switch. The electricity grabbed me. I got burned pretty badly but managed to cut the generator off and get the fire out of the building. From that day to this, I've had to wear glasses.

"Back in 1927, I was talking on the phone during a storm when lightning hit a transformer on a pole in the yard and ran into the house. I was knocked through a hall and onto the back porch. When I came to, I was still holding the receiver in one hand."

Since 1935, the Eury powerhouse has been operated automatically, but Richardson has found plenty to do in the way of maintenance.

Richardson, 63, plans to move to nearby Mount Gilead. Of this prospect he says: "The worst thing about moving to Mount Gilead is having to get used to all the noise there." END



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Heat protection hits a new high in B-E-H #1 Plus Insulating Cement for uneven surfaces, fittings, pipes and valves. Now effective up to 2100 F . . . B-E-H #1 Plus provides a comfortable margin of protection that insures excellent thermal efficiency even on installations not normally subject to super-high temperatures.

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new engineering books

The Training, Placement and Utilization of Engineers and Technicians in the Soviet Union; 112 pages, 5½ by 8½ in., paper cover. Published by Engineers Joint Council, Inc., 29 West 39th St., New York 18, N.Y. Price $1.

This is an evaluation of the training, allocation and utilization of professional engineers and semi-professional technicians in the USSR. It is based on a tour of the Soviet Union made last year by six representatives of United States engineers. The tour was sponsored by Engineers Joint Council with financial support of the National Science Foundation and under an exchange agreement between the U.S. and the USSR.

Each of the six sections of the report was written by a member of the delegation whose professional background qualified him to evaluate specific aspects of Soviet engineering:

1. Engineering and Technicum education in the USSR.
2. Planning of Manpower Requirements and Placement of Graduates.
3. Continuing Education of Engineers and Technicians Employed in Soviet Industry.
4. Motivation in Education.
5. Industrial Research.
6. Utilization of Engineers and Technicians.

Soviet engineering institutes are comparable to engineering colleges in the U.S. The Soviet technicum is a counterpart of the American technical institute or technical junior college. A high degree of practical industrial experience is integrated into the study program of both institute and technicum students.

It is pointed out that Soviet secondary education prepares highly qualified students for advanced education and that the Soviet freshman is generally better prepared for an engineering education than his American counterpart.

Revealing observations are made on the motivations underlying the strong educational desires of the Russians. Among these are a strong sense of patriotism, the preferential financial compensation, the better standard of living for the technically educated, the higher social prestige which exceeds that held by Americans of like status, and virtual exemption from military service.

A brief concluding section outlines the delegation's views of the implications for the United States presented by the Soviet emphasis on engineering and engineering education. One of these is the impact on our foreign relations made by the Soviet readiness to deploy engineers and technicians in underdeveloped countries.

The Consulting Engineer, by C. Maxwell Stanley; 258 pages, 5¼ by 8¼ in., cloth bound. Published by John Wiley & Sons, Inc., 440 Park Ave. South, New York 16, N.Y. Price $5.95.

Organized in two parts, this book discusses the consulting engineer's relationships to his client, to other consultants, and to the public; then goes on to deal with internal problems of a consulting practice. Emphasis is placed on operation of a consulting practice as such, and not on the technical engineering problems involved in construction and design.

An engineering graduate from the State University of Iowa in 1926, C. Maxwell Stanley is senior partner of the Stanley Engineering Co. and has had a wide and diversified experience in consulting in the U.S. and abroad.

Evaporative Cooling of Circulating Water, by L. D. Berman; 392 pages, 8½ by 11 in., board binding. Published by Pergamon Press, Inc., 122 E. 55th St., New York 22, N. Y. Price $20.

Considerable work has been done in the USSR in the last 20 years to improve the operation of equipment for evaporative cooling of water. This book, translated from the Russian, aims to give a systematic account of the basic problems of the theory, design and use of coolers, and thus make conveniently available the extensive data obtained by Russian workers in this field.

The book is in two parts. Part one deals with heat transfer during evaporative cooling, and with problems of the theory of coolers. Part two takes up evaporative cooling of circulating water in practice.

Standard for the Installation and Operation of Pulverized-Fuel Systems; 32 pages, 4¾ by 7¼ in., paper cover. Published by National Fire Protection Association, 60 Batterymarch St., Boston 10, Mass. Single copy price 60 cents, discounts on quantity orders.

This 1961 revision supersedes previous editions of NFPA Standard No. 60, which contained the requirement that all equipment containing dust-laden air and operating at or near atmospheric pressure be designed to withstand an internal pressure of 50 psig. The provision was revised in 1961 to limit the requirement to "all equipment of the pulverized-fuel system." This revision eliminates the need for such construction for ducts beyond the burner.

An additional change allows hot gas to be used for drying only if it does not contain combustible material having volatile matter in excess of 8 per cent.

Magnetic Control of Industrial Motors, Part II: A-C Motor Controllers, by Gerhart W. Heumann; 334 pages, 6 by 9¼ in., cloth bound. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N.Y. Price $9.

This is volume 2 of a three-volume set which is based on the author's previous book of the same name. Material in Part II covers essentially the same things as chapters 3, 12, 14, 16, 17, 19 in the previous book. Chapters on wound rotor motors and on protection have been greatly expanded.

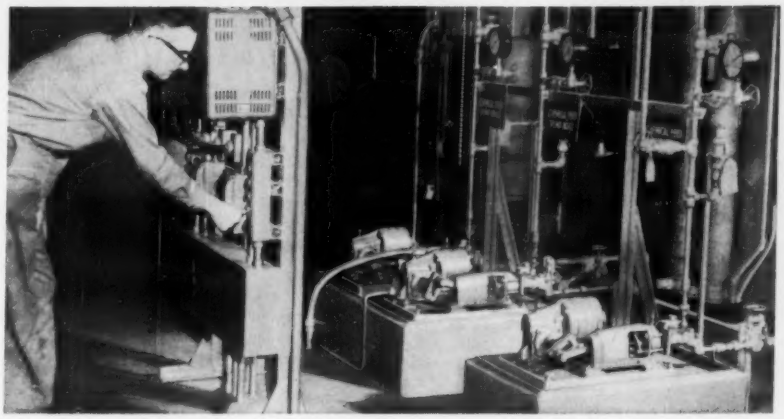
Treatment of motor characteristics and their control has been rearranged, so that performance of a certain type of motor and its control are treated in the same chapter.

A new chapter discusses static switching and the concept of logic functions, an important step in simplifying circuit design for complex control systems.

Since publication of the previous book, there have been many changes in industrial practices affecting the design of motors and control apparatus. This new set of books reflects these changes by inclusion of considerable new material and the elimination of obsolete designs.

how to select the right metering pump for water treatment

SOFTENING, demineralizing, pH control, oxygen scavenging . . . all of the treatments commonly applied to water place special demands on chemical feed systems. Chemicals must be metered to a high degree of accuracy, but many of them, particularly the strong acids and alkalies, are themselves highly corrosive. Through the years, controlled volume pumps have proved the ideal metering technique in this field, combining accuracy, controllability, and corrosion resistance. But the question often arises, "Which controlled volume pump design is best for my water treatment needs?" Here are a few practical suggestions based on actual experience.



Standard Milton Roy MD pumps meter ammonium hydroxide to maintain desired boiler feedwater pH at Ohio Power Company. Milton Roy miniPumps also feed minute amounts of hydrazine to remove residual oxygen from feedwater at this generating station.

PUMP SELECTION GUIDE

FOR	USE THIS PUMP TYPE
Coagulation	
alum	MD
silicate	MD
Demineralization	
acid regeneration	Diaphragm / Mersemetric
alkali regeneration	Diaphragm
Softening	
conc. phosphoric acid	Diaphragm
conc. sulfuric acid	Diaphragm / Mersemetric
lime slurries	MD
phosphates	MD / H20
soda ash solution	MD
Oxygen Scavenging (Boiler Water)	
sodium sulfite	MD / H20
hydrazine	MD / miniPump
Calcium Precipitation (Boiler Water)	
phosphates	MD / H20
Carbon Dioxide (Boiler Water)	
neutralizing amines	MD / H20
filming amines	MD / H20
pH Control (Boiler Water, Process Water, Cooling Towers)	
caustic soda	Diaphragm / Mersemetric
sulfuric acid	Diaphragm / Mersemetric

Packed plunger pumps . . . MD, H20®, miniPump®

The standard Milton Roy MD pump is usually the first choice for metering water treatment chemicals. Highly accurate, its capacity is readily varied manually or automatically in response to treatment demands. A wide variety of materials of construction from cast iron to stainless steel withstand all mildly corrosive treatment chemicals. Capacities to 2056 gph, pressures to 1000 psi. *Bulletin 553-1.*

Non-corrosive chemicals can be metered economically with the H20 pump if constant speed operation is satisfactory. Though it cannot be adjusted in operation, this low cost pump is ideal for feed to packaged boilers. Capacities to 28 gph, pressures to 600 psi. *Bulletin 558-3.*

When extremely small volumes of chemical, from 20 to 2940 milliliters per hour, must be metered to accuracies of 1%, the Milton Roy miniPump is the right answer. That's why this design is just about standard for metering hydrazine in oxygen scavenging. Pressures to 1000 psi. *Bulletin 1257-2.*

Diaphragm liquid ends

The best pump for highly corrosive or otherwise dangerous treatment chemicals is the diaphragm pump, with a stainless steel or plastic diaphragm isolating the plunger from the treatment chemical. Positive air purging at each stroke eliminates any chance of air binding. And the diaphragm liquid end is readily interchangeable with the packed plunger liquid end of the standard MD pump, permitting economical modernization in the event of a change in metering requirements. Capacities to 400 gph, pressures to 2700 psi. *Bulletin 1157-2.*

Totally immersed liquid ends . . . Mersemetric®

Many special metering problems are easily solved by Mersemetric controlled volume pumps with the liquid end submerged to a depth of up to fourteen feet. Chemicals can be metered directly from storage tanks without any need for tank connections below liquid level. Mersemetric pumps are widely used to feed sulfuric acid to cooling tower water and deaerator effluent, and sulfuric acid or caustic soda for demineralizer regeneration. Capacities to 218 gph, pressures to 1200 psi. *Bulletin 1153C.*

If precision pumping of boiler water treatment chemicals is one of your problems, look again to Milton Roy's 25 years of experience for your most economical solution. Milton Roy Company, 1300 East Mermaid Lane, Philadelphia 18, Pennsylvania.

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Controlled Volume Pumps
Colorimetric Analyzers
Hydrogen Purifiers
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1936-1961
25 YEARS

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new power construction

Phoenix, Ariz.—Arizona Public Service Co., 501 S. Third St., has authorized plans for capital outlays to exceed $70,000,000 this calendar year, a total up sharply from $26,800,000 expended in 1960. Most of the spending is aimed at increasing the generating capacity of the company's system to fulfill the area's ever increasing customer demand. New customers have increased the company's general business electricity sales 11 per cent in the last 12 months, and a greater increase is anticipated in the year ahead. Work on the company's Four Corners Power Plant is proceeding according to plan at Fruitland, N.M., and when placed in service in early 1964 will increase generating capacity by 350,000 kw.

Fontana, Calif.—Southern California Edison Co., 500 W. Fifth St., Los Angeles, has applied for permission to the California Public Utilities Commission to build a fourth unit at its Etiwanda Power Plant located here. New proposed unit will have an initial capacity of 310,000 kw, similar to those previously installed at this plant, and will cost an estimated $37,000,000.

Pasadena, Calif.—Pasadena Municipal Light & Power Department, City Hall, 100 N. Garfield Ave., has authorized contract award of $2,500,000 to the Allis-Chalmers Manufacturing Co., Milwaukee, Wis., for construction installation of a 71,000-kw steam-electric generating unit in the municipal power station here. Preliminary work on the site and foundations has begun, and the new unit is expected to go into operation early in 1964.

San Diego, Calif.—San Diego Gas & Electric Co., 861 Sixth Ave., has announced plans for the payment of 20 per cent of the cost of constructing and operating a nuclear-fueled steam-electric generating plant, in participation with Southern California Edison Co., Los Angeles. The total cost of the plant, including land, will approximate $78,000,000, making San Diego Gas & Electric's cost about $15,600,000. Companies are paying about $10,000,000 for land and improvements and about $68,000,000 for the Westinghouse reactor and equipment to supply steam to a 375,000-kw turbine-generator. Plant is expected to be in operation by the summer of 1965 and will be located between the participating companies' load centers.

San Francisco, Calif.—Pacific Gas & Electric Co., 245 Market St., has announced that it has been granted a license by the Federal Power Commission for a major hydroelectric project on the McCloud and Pit Rivers in northern California. The planned system includes four dams, four tunnels and three powerhouses which will have a generating capacity of 329,400 kw and will cost over $87,000,000 when completed in 1965 or 1966. Company has not yet announced a construction schedule, but first construction contracts probably will be awarded the latter part of 1962. PG&E has announced that it expects to double its generating capacity from 5,000,000 kw to 10,000,000 kw by 1970.

Jacksonville, Fla.—City of Jacksonville, Department of Light & Power, City Hall, is considering plans to construct a 69-kv pipe-type electrical cable from municipal Talleyrand Power Station to Randall Street substation in this city. Work when authorized will take from twelve to eighteen months to complete. Total cost is reported to be approximately $1,200,000, which will be raised by bond issue. Bids for the work were rejected earlier this year but will be presented again in what is considered a more favorable market in the near future.

Kahe Valley, Hawaii—Hawaiian Electric Co., 900 Richards St., Honolulu, has authorized plans and will start construction soon on the installation of a new steam-electric generating unit on a large site here, recently selected for the purpose. New unit will have an initial capacity of 82,500 kw and upon completion will represent an investment of approximately $5,500,000. Contract for the work, which will begin at once, has been awarded to Hawaiian Dredging and Construction and Bechtel Corp., 1350 Ala Moana Boulevard, also of Honolulu. Plant is scheduled for completion the early part of 1964.

Marion, Ill.—Southern Illinois Power Cooperative, Steelville, Ill., has authorized plans and will start construction soon on a new power plant on nearby South Fork Saline River, where a large site was recently selected. New facility will be equipped with a steam-electric generating unit with a capacity of 99,000 kw, high-pressure boilers, and auxiliary equipment to be installed by Huber, Hunt & Nichols, Inc., Indianapolis, Ind., at a cost of $3,000,000. Burns & McDonnell Engineering Co., Kansas City, Mo., is consulting engineer of the project, which will cost $25,600,000, including caisson for the foundation and plant and equipment. Work will begin later this year for completion scheduled for fall of 1963.

Shreveport, La.—Eleven investor-owned electric companies which form the Southwest Power Pool have offered to exchange electric power with the Tennessee Valley Authority in off-peak periods. It is estimated that the exchange would effect considerable economies for both the TVA and member companies. Exchange of power is feasible because TVA has a high demand in the winter. Under the plan, TVA surplus summer power would be exchanged for company surplus in winter. According to the proposal, an exchange of 1,500,000 kw of capacity is envisioned at a construction cost of $10 per kilowatt. This would be a saving of $150,000,000 to the companies. An estimated $90,000,000 would be required for transmission facilities to meet power needs.

Baltimore, Md.—Baltimore Gas & Electric Co., Lexington Building, has announced plans for capital spending of about $45,000,000 this year and slightly more in 1962. Outlays of $250,000,000 are planned for the 1961-1965 period which when completed will increase the utility's generating capacity by nearly 50 per cent. Company expects to finance its expansion program in the first half of 1962 by offering about $30,000,000 in mortgage bonds.

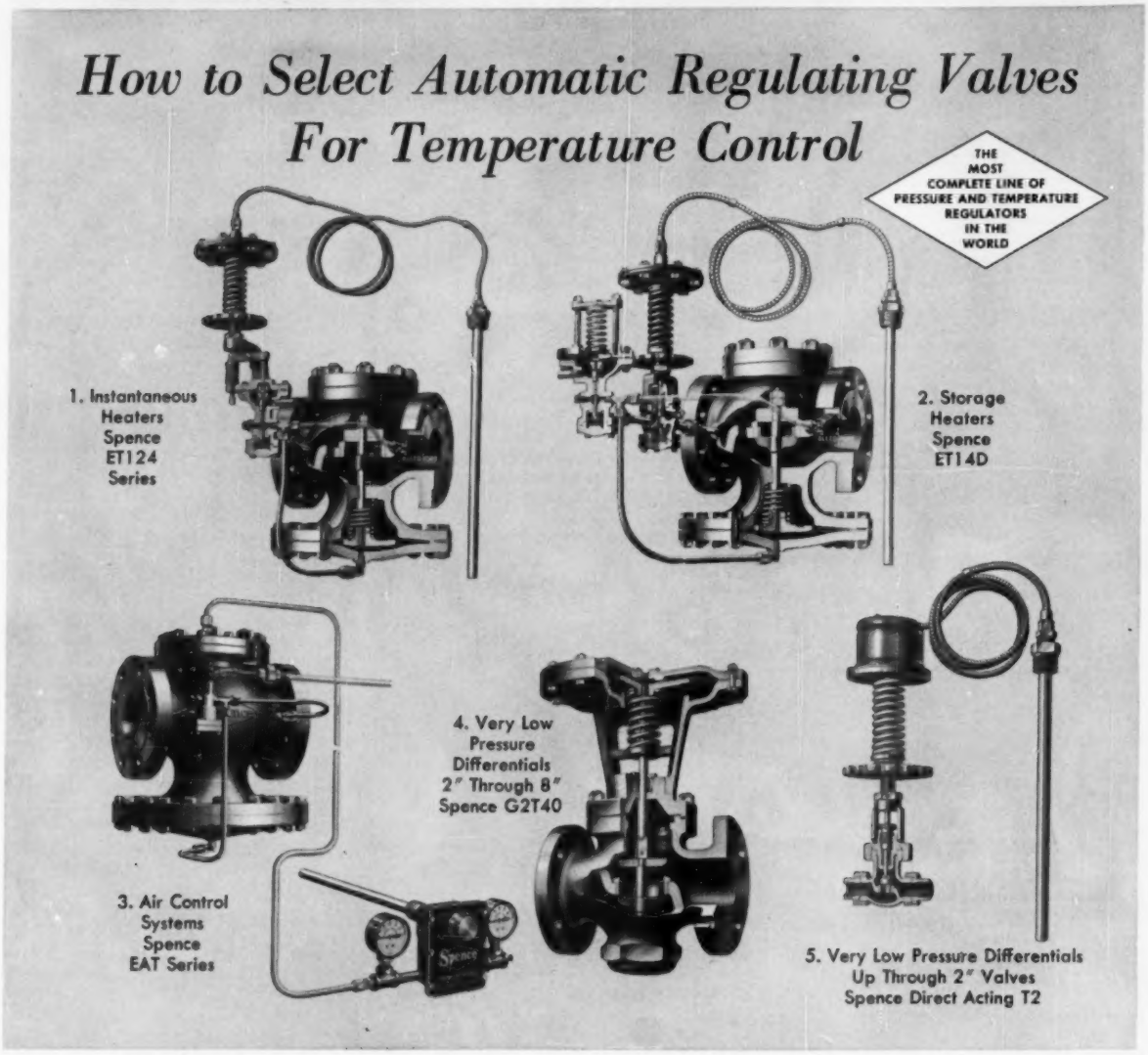
Springfield, Mo.—City Purchasing Agent, 301 E. Central St., has authorized contract award to the Allis-Chalmers Manufacturing Co., Milwaukee, Wis., for construction and installation of the fourth unit turbine-generator addition at the municipal power plant here. New unit to be installed at the James River Power Plant will have an initial capacity of 60,000 kw and will cost approximately $2,200,000. Work will begin this year for completion scheduled for early 1964. Burns & McDonnell Engineering Co., Kansas City, Mo., is consulting engineer of the project.

Franklin Square, N.Y.—Long Island Lighting Co., 250 Old County Road, Mineola, N.Y., has announced acquisition of a five-acre site for the construction of a new power substation at Hempstead Turnpike east of Grand Street. Work on the new venture will get under way soon for completion scheduled in the late fall of 1962. Cost of the project is reported to be just under $1,000,000.

Cleveland, O.—Cleveland Electric Illuminating Co., Illuminating Building, has authorized plans to construct a 54-mile, 345,000-volt transmission

VALVE TIPS:

How to Select Automatic Regulating Valves For Temperature Control


THE MOST COMPLETE LINE OF PRESSURE AND TEMPERATURE REGULATORS IN THE WORLD
1. Instantaneous Heaters Spence ET124 Series
2. Storage Heaters Spence ET14D
3. Air Control Systems Spence EAT Series
4. Very Low Pressure Differentials 2" Through 8" Spence G2T40
5. Very Low Pressure Differentials Up Through 2" Valves Spence Direct Acting T2

During the past year, our field representatives have reported many cases of improperly, and uneconomically, applied temperature regulators. To help you avoid some of these costly mistakes, here are a few tips on selecting the most effective and economical temperature regulating valves for your applications.

1. Instantaneous heaters require a special action for close temperature control and freedom from hunting. In the Spence ET124 series, steam pressure is modulated according to temperature (demand) and is automatically regulated at any pressure established by the demand.
2. Storage heaters, on the other hand, are more economically controlled by the Spence ET14D, which includes a simple temperature-actuated pilot that opens and closes the main valve to maintain a constant temperature.
3. Air control systems can now have a ±5°F control accuracy under wide and instantaneous load swings with the Spence EAT regulator. Engineers report savings of up to 50% in installed costs with this recently developed Spence cascade system when it has been used in place of conventional instrumentation.
4. For the combination of very low pressure differentials and air or water control, Spence recommends Type G2T40. This single seated pilot operated valve provides fast, positive response in 2" through 8" valves. Double seat Type G22 is also available in 10" through 12".

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5. When very low pressure differential is encountered with valves of 2" or less, the Spence direct operated T2 is recommended. The sensitive vapor tension thermostat responds quickly to small changes in bulb temperature for continuous, accurate control.

In this brief description of industrial process and heating temperature control, we have given a few important tips in proper regulator selection. If you would like more detailed information on these control applications, write for the new Spence Temperature Control Bulletin IV 1014. SE-150

SPENCE ENGINEERING COMPANY, INC.
Walden 1, N. Y.
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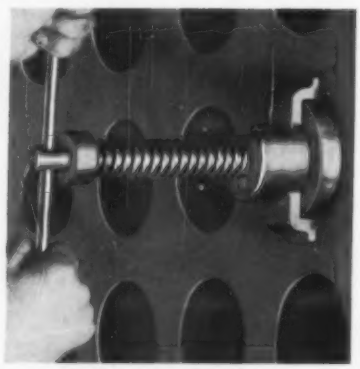
Roto Hand-hole Seat Scraper makes short work of cleaning dirty hand-hole seats. This simple, hand-operated tool has adjustable, spring-mounted retractable knives. A few turns to the right remove foreign matter without cutting the metal. A half turn to the left releases the tool, and the job is done. Customers say that the Roto Seat Scraper does the job up to 12 times faster than by any other method. Try one and you'll wonder how you ever got along without it. *Send for details.*

Now available

for most hand-hole shapes and sizes

Standard Roto Seat Scrapers are available for the following equipment. Special types made to order.



Illustrating ease of operation of Roto Hand-hole Seat Scraper.

Type of Boiler	Opening	Tube Size
Babcock & Wilcox # 4	Round	2"
" " " #41	Oval	2"
" " " #70	Round	3"
" " " #48	Oval	3½"
" " " #40	Oval	3¼"
" " " #24	Oval	4"
" " "	Oblong	4"
Bros	Round	3¼"
Casey Hedges	Oval	3½"
" "	Oval	4"
Combustion Eng'rg	Round	3"
" "	Oval	3"
Edgemoor	Oval	4"
Erie City	Ellip	2½"
" "	Oblong	3¼"
" "	Ellip	3¼"
" "	Pear	4"
Foster Wheeler	Oblong	2½"
" "	Oblong	3"
" "	Ellip	4"
Geary	Oblong	4"

Type of Boiler	Opening	Tube Size
Heine	Round	3½"
"	Oval	3½"
International Boiler 2	Oblong	3"
Keeler	Round	3½"
"	Round	4"
"	Diamond	3½"
"	Diamond	4"
Lasker	Oblong	
Murray	Oval	3½"
"	Oblong	4"
Oil City	Oval	3½"
" "	Oblong	4"
Riley Stoker	Ellip	3¼"
Springfield	Ellip	3¼"
Union Iron Works	Pear	4"
Henry Vogt	Ellip	3¼"
" "	Oval	4"
Walsh & Weidner	Oval	4"
Wickes	Ellip	2½"
"	Ellip	3¼"
"	Pear	4"
"	Round	4"

ELLIOTT COMPANY – ROTO PLANT

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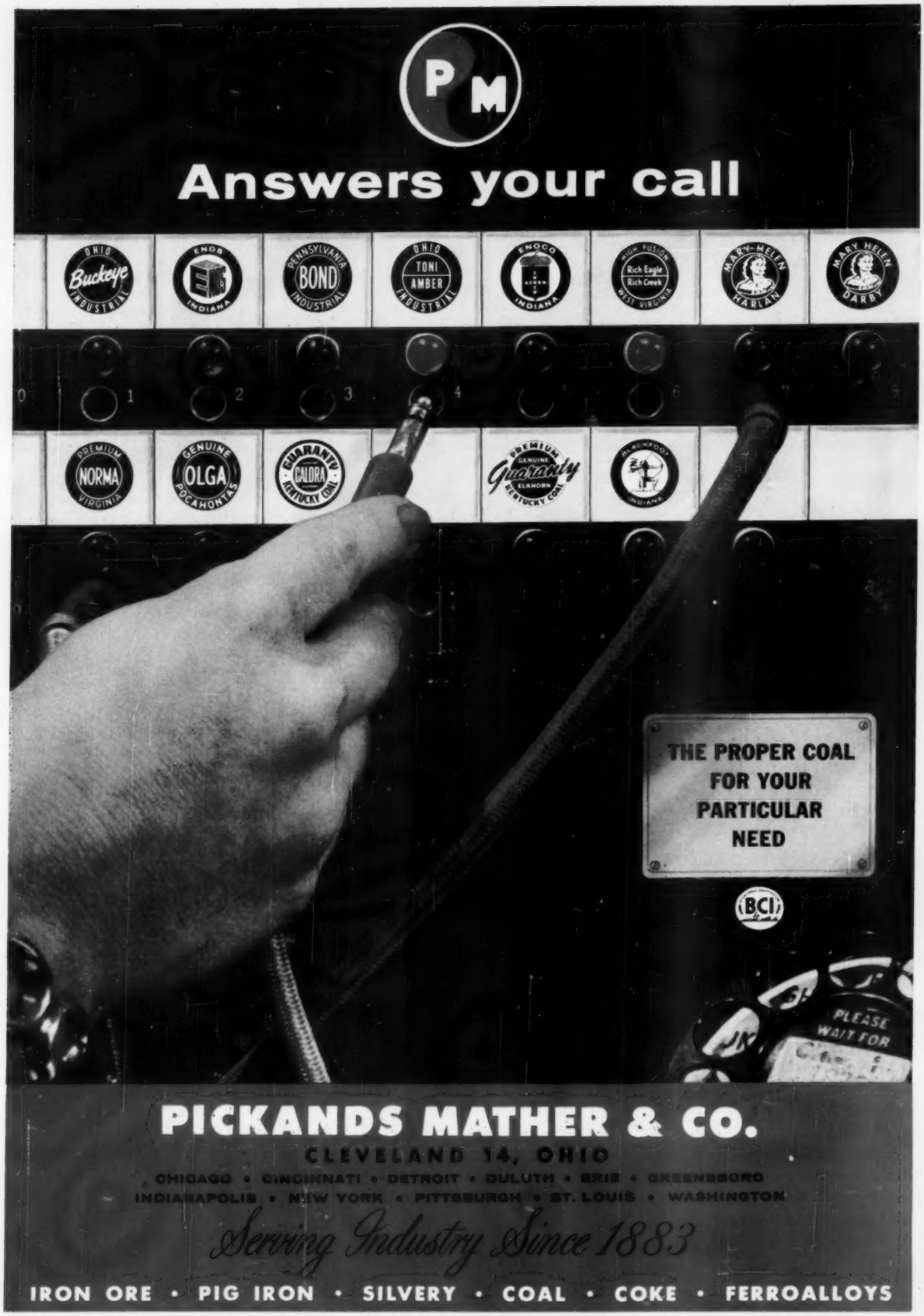
line through its service area in Summit, Portage and Stark Counties. Work is scheduled to begin soon for completion in the fall of 1963 at a cost over $5,500,000.

Euclid, O.—Addressograph-Multigraph Corp., 1251 Babbit Rd., Cleveland, has disclosed plans for a 42 per cent expansion of its manufacturing and storage capacity, to cost more than $8,000,000, at its main plant in this Cleveland suburb. Plans call for installation of a new boilerhouse, boilers and auxiliary equipment. Work is already under way and will be completed by the summer of 1963. Additional capacity is planned to take care of increased demand for the company's business machines, provide improvements in factory operations and allow for expansion of new products. It was reported that the boilerhouse additions and boiler installation would cost about $500,000.

Johnstown, Pa.—Pennsylvania Electric Co., a subsidiary of General Public Utilities Corp., 222 Levergood St., Johnstown, Pa., is considering plans to acquire about half of the electric distribution properties now operated by Carpenter Light & Power Co., subject to approval of regulatory bodies. This company sells electricity to about 5800 customers in northwestern Pennsylvania. A subsidiary of the Ohio Edison Co., Pennsylvania Power Company, New Castle, Pa., will acquire the other half of Carpenter. The General Public subsidiary will pay about $1,100,000 of the purchase price. General Public is a holding company with operating subsidiaries in New Jersey, Pennsylvania and the Philippines.

San Antonio, Texas—City Public Service Board, Navarro and Villita Sts., has plans under consideration to install a fourth unit at the municipal power plant here. Installation of the turbine-generator electric power plant at W. B. Tuttle Power Plant is reported to represent an investment exceeding $5,000,000. Work on the new unit is expected to begin early next year for completion in the spring of 1964. Gibbs & Hill, Pennsylvania Station Building, New York, N.Y., is consulting engineer.

Victoria, Texas—Central Power & Light Co., 120 N. Chaparral St., Corpus Christi, has authorized a major expansion of its facilities here for increased capacity. Plans include installation of a steam-electric generating unit with a capacity of 175,000 kw at a cost of $12,000,000; electric power transmission lines, $750,000; grounds and earthwork for the power plant area, $150,000; machine repair shop, $200,000; and reinforced concrete and steel foundation for the power plant at a cost of $400,000. Work will begin late this year for completion in early 1964. Sargent & Lundy, Chicago, Ill.,



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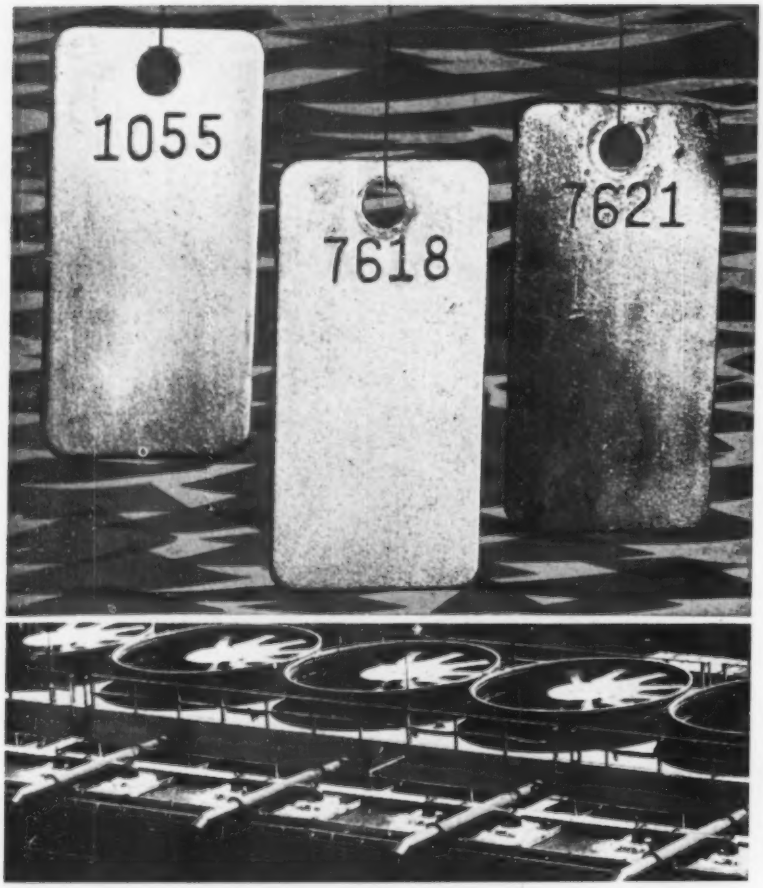


in test after test
HAGATREAT IS MOST EFFECTIVE ... AT LOWEST COST PER DAY

Plant tests designed to determine which corrosion inhibitor provides the *lowest cost per degree of protection* usually indicate Hagatreat as the winner by a wide margin. Here are the results on test strips from one such test:

Specimen No.	Location	Treatment	corrosion rate mg/dm²/day	corrosion rate mils/yr
1055 (copper)	Blowdown	Hagatreat 168	0.41	0.06
7618 (steel)	Tower Sump	Hagatreat 168	0.58	0.11
7621 (steel)	Blowdown	Hagatreat 168	1.1	0.20

The low corrosion rate registered here is typical of Hagatreat results in plants all over the country. Hagatreat is effective with steel, copper, aluminum; in fact, complete treatment as recommended by the Hagan engineer is designed to protect the entire system, from cooling towers on through.

Complete information on Hagatreat or any of the Hagan water treatment chemicals is available on request. Write or phone for a Hagan engineer, or ask for the Hagatreat Bulletin—No. CSP-935.

HAGAN
CHEMICALS & CONTROLS, INC.
HAGAN CENTER, PITTSBURGH 30, PA.

HAGAN DIVISIONS: CALGON CO. • HALL LABORATORIES • BRUNER CORP.

For more data circle 534 on Post Card

is serving as the consulting engineer for all of the units.

Green Bay, Wis.—Wisconsin Public Service Corp., 600 N. Adams St., Milwaukee, Wis., has authorized plans to construct a new steam-electric generating unit, with an initial capacity of 125,000 kw, at its Green Bay Power Station here. Work on the new unit will begin in early 1962 and when completed will increase the utility's generating capacity to 615,000 kw. The new unit is scheduled to be completed in the third quarter of 1964 at a cost reported to exceed $20,000,000. Installation of the unit was made feasible by an agreement to pool power with Wisconsin Power & Light Co., Madison, under which any excess capacity temporarily available will be sold to the other member of the pool.

Around the power circuit

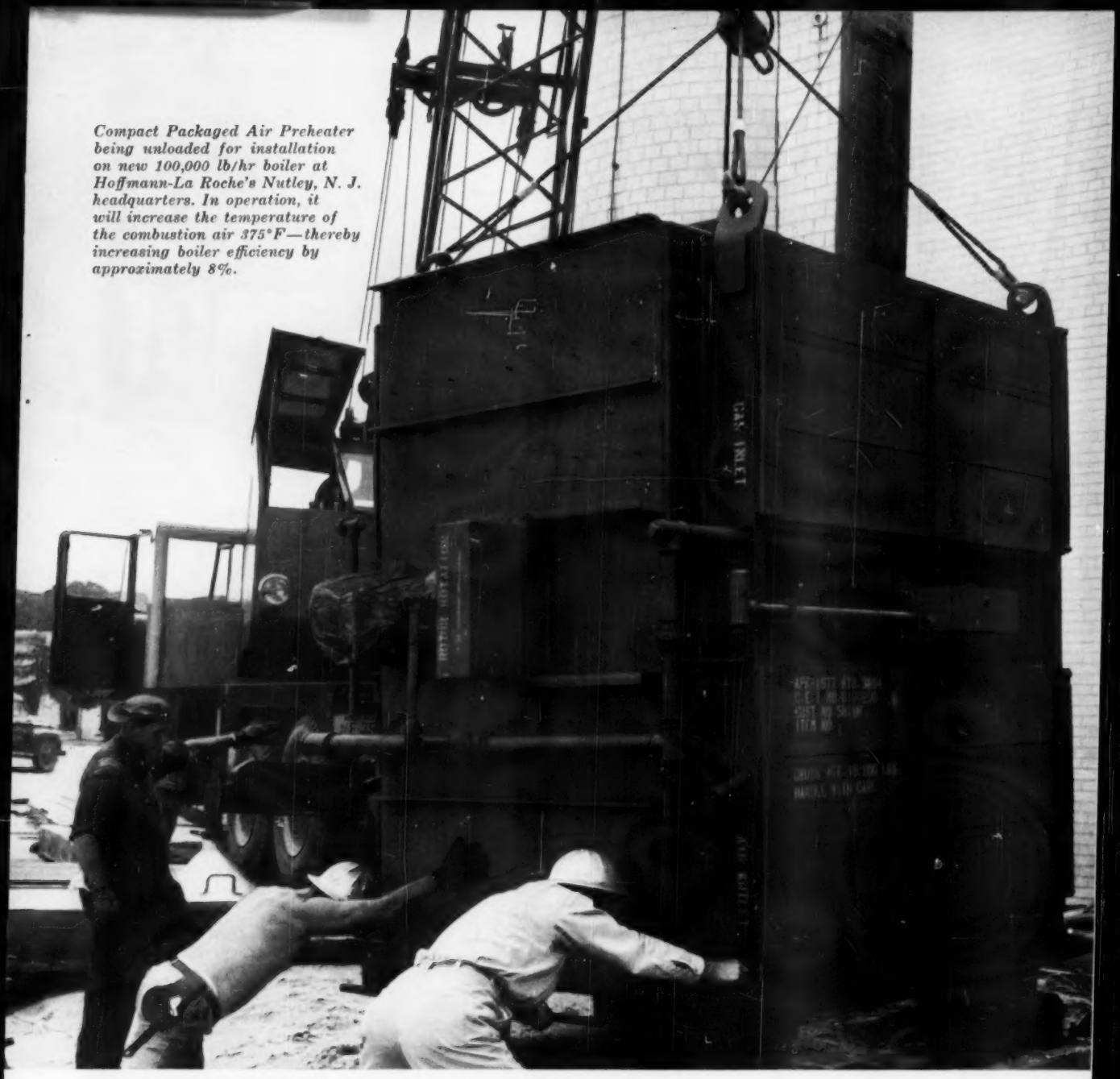
Continued from page 6

Stations **is included in a collection of 10 articles on Soviet precision equipment—compiled from various USSR periodicals—available in English through the Office of Technical Services, Business and Defense Services Administration, U.S. Department of Commerce, Washington 25.**

DIRECTORS of Public Service Co. of Colorado and Colorado Central Power Co. have approved an agreement and plan of merger of the two companies. The surviving company will be known as Public Service Co. of Colorado.

TWENTY of industry's largest air-blast power circuit breakers, made by GE, will protect the Southwest's first 345-kv transmission system, a 310-mile line from a New Mexico Indian Reservation to Phoenix, Arizona. The breakers are to be used in Arizona Public Service Co.'s Four Corners project. Four of them are rated 345-kv, 2-cycle, 15,000-mva units. The rest are 230-kv, 15,000-mva, 2- and 3-cycle units.

POWER AUTHORITY of the State of New York has settled its contract with the joint venture of Perini, Walsh, Morrison-Knudsen, Kiewit



Compact Packaged Air Preheater being unloaded for installation on new 100,000 lb/hr boiler at Hoffmann-La Roche's Nutley, N. J. headquarters. In operation, it will increase the temperature of the combustion air 375°F—thereby increasing boiler efficiency by approximately 8%.

PACKAGED AIR PREHEATER

WILL RECOVER 330°F FROM NEW BOILER FOR HOFFMANN-LA ROCHE INCORPORATED

Hoffmann-La Roche, one of the leading producers of pharmaceuticals, vitamins and aromatic chemicals, specified a Ljungstrom Packaged Air Preheater for their new boiler for three reasons: 1) This compact, preassembled unit is ready to run as soon as it's connected to the power line and ducts—no extra installation or erection costs; 2) The unit occupies only about 450 cubic feet of space but will cut boiler exhaust temperatures from 680°F to 330°F—for about 8% saving in fuel; 3) Savings in fuel alone—roughly 1% for every 40°F drop in exit gas temperature—can pay for the unit in two short years!

Packaged Ljungstroms are available in sizes for use on boilers in the 25,000 to 250,000 lb/hr range—can give you these same fuel saving advantages. For full information, write today for our 14-page Packaged Air Preheater booklet.

THE AIR PREHEATER CORPORATION

60 East 42nd Street, New York 17, N. Y

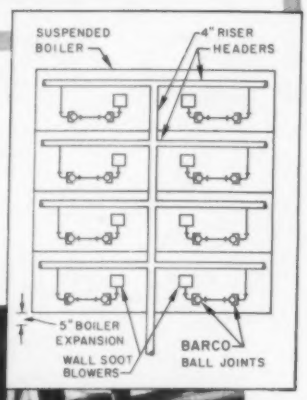
For more data circle 535 on Post Card

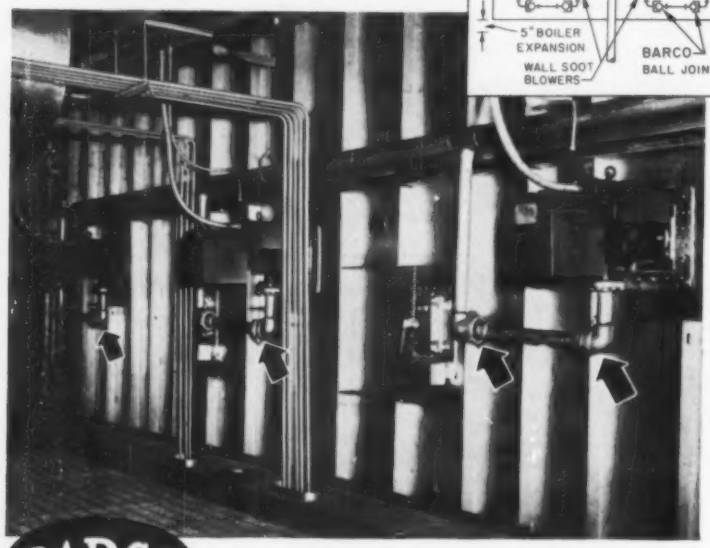
Better Flexible Connections for SOOT BLOWERS

IN PENNSYLVANIA—

(See diagram and photo) This suspended steam generator moves downward 5" or more between "cold" and "hot" positions. Barco Ball Joints on lines to the soot blowers easily allow movement and eliminate twisting stresses. Service: 300 psi air, ambient temperature (also suitable for steam). Three years experience with 62 joints installed here shows no maintenance required.

(Photo: Pennsylvania Power Co., New Castle, Pa. Consulting Engineer: Commonwealth Associates Inc., Jackson, Mich.)





BARCO **BALL JOINTS**

SAVE PIPE – 30° FLEX!

Many Barco Ball Joints are now going into soot blower piping connections. Here's why:

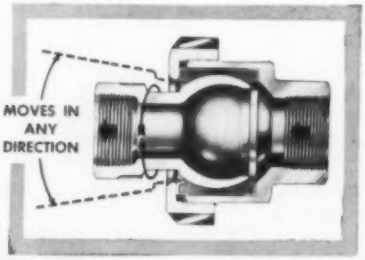
MORE FLEX! SHORTER PIPE! Instead of allowing only ½" flex per foot of pipe, Barco provides up to 6".

PRESSURE-SAFE—No danger of blow-outs. Joints contain no material that gets "tired" or deteriorates. Safe for alternate use with high temperature steam.

SAVE TIME—Piping design simplified. Easy to solve complex pipe movement problems with minimum engineering time.

NO MAINTENANCE NUISANCE—Joints work without attention or inspection. No lubrication. No periodic replacement. Always "self-aligning".

Besides use on Soot Blowers, Barco Ball Joints in power plants are now finding application on steam exhaust relief lines, feedwater connections, acid cleaning lines, gas lines, pump connections, and expansion loops. They provide many advantages: FIRE-SAFE and virtually indestructible; easy to engineer — develop no "end thrust", don't require anchoring. Sizes and styles for every purpose; threaded, flanged, or welding ends. *Ask for complete information.* SEND FOR CATALOG 250.



BARCO MANUFACTURING CO.
547M Hough St., Barrington, Illinois
In Canada: The Holden Co., Ltd., Montreal

For more data circle 536 on Post Card

and Utah, contractors for the Robert Moses Power Dam.

This settlement, involving a total cost to the Authority of $59 million, is the last in connection with the entire St. Lawrence Power Project.

Work started in August 1954; first power was generated in July 1958 and the installation of the last of the 16 generators on the U.S. side was completed one year later.

The St. Lawrence project has an installed capacity of 1,880,000 kilowatts divided equally between Ontario Hydro and the Power Authority. All of the United States' share of the St. Lawrence power has been marketed and is now being used by industry and rural and domestic consumers within the economic marketing area, which is generally that within 150 miles.

TWO 117,000-hp vertical pump turbines and inlet control valves have been ordered from Allis-Chalmers by the Tokyo Electric Power Co. of Japan. Operating under a 318-ft net head, the new 150-rpm units will each generate 85,000 kw for Tokyo and its surrounding area. When operating as pumps, each unit will discharge over 3775 cfs against a 238-ft head. The Yagisawa Power Plant will be the river flow storage-type.

AN AGREEMENT has been worked out which permits enactment of legislation creating a Delaware River Basin Compact Commission, in which the Federal Government would participate with the States in planning development of the area's industrial, recreational and flood control features.

Under the terms of the legislation, the Delaware River Compact Commission would consist of the governors of the States of New York, New Jersey, Delaware, and Pennsylvania, and a representative of the Federal Government appointed by the President.

The Commission would operate as an agency of all the States and the Federal Government and would be authorized to develop plans, policies, and projects relating to the water resources of the basin area.

POLE 100 FEET LONG is being used as a safety device at Purdue

ONE OF A SERIES OF CHATS ABOUT CONSERVATION AND CONTROL OF HEAT

SARCO TOPICS

SO YOU THINK YOU'VE GOT TEMPERATURE CONTROL PROBLEMS

When plant men get together and talk about their temperature control problems, strong men may weep. It's so darned basic—that narrow range of degrees which must be maintained—so closely allied to profit and loss. Let us tell you about one situation that may even top yours, and may clue you in on a good solution. It concerns wine, of all things.

Take those basic temperatures. Wine must be pasteurized at 140°F. Those are the facts of life in the world of wine. They might not seem too difficult to live with unless you are concerned with heat. Then you probably know how tough things can get when you have a rendezvous with a thermometer.

Take New York's Monarch Wine Company, producers of Manischewitz Wines. Their Problem: how to maintain the 140° temperature in the heat exchangers despite wide variations in the rate of wine flow. These variations, between 5 to 60 gallons per minute, result from slowdowns and recoveries in the bottling process. Problem: entire system must be capable of complete shutdown when necessary. Problem: wine temperatures must be raised to 140° as rapidly as possible, sometimes an immediate jump of 100°.

Attracted perhaps by aspects of the situation that had little to do with pure science, Sarco engineers applied the collective experience of Sarco technology to the solution of this serious problem. The result for Monarch: the *degree of control* the process demanded—achieved through the excellent use of Sarco Temperature-Pressure Regulators, Float Thermostatic Steam Traps Thermo-Dynamic Steam Traps, and Pipeline Strainers.

Sarco engineers, ever resourceful, divided each of the two large Cherry-Burrell plate-type heat exchanger units into two separate

sections with a blank baffle plate, each with a separate Sarco control. Thermal sensing bulbs were installed in wine discharge and throttling controls hooked into steam supply. As demand fluctuates, one or both regulators function to maintain the 140° temperature. In higher demand, both regulators are operative; as demand drops and flow decreases, only one regulator supplies steam. Pasteur himself would have been elated.

Each of six smaller capacity shell-and-tube heat exchangers required only one regulator, with the sensing bulb inserted into the outlet side of the wine filled shell, and the regulator throttling steam supply to the tube section. Thus, by controlling flow of steam to the exchangers on the basis of pressure and temperature, the Sarco regulators were able to maintain the temperature of the wine at precisely 140° regardless of fluctuations in demand or supply rate. Whew! A lot of engineering went into those two sentences.

From here on it's downhill. To secure complete cut off of the steam supply during scheduled shut-downs of the bottling run, solenoid valves were provided to supplement normal modulating action of the controls. To discharge widely varying loads of condensate continuously and remove immediately all air and incondensible gases, Sarco Float Thermostatic Steam Traps were installed on all condensate outlets. On the drips before each control valve a Sarco Thermo-Dynamic Steam Trap was installed to insure delivery of dry steam. Sarco Pipeline Strainers were installed before all steam traps and valves to protect them against damage by any foreign bodies. And thus ends a classic story of the grape.

Still, this story has been condensed far too much, really, and we feel you've been cheated out of the story's more delicious details. You needn't be, however. We've printed the facts in detail for posterity and you in Sarco Case History 185, complete with drawings that practically make it a do-it-yourself kit. If you would like a copy, we will be flattered to receive your request, and dispatch it with dispatch.

WE'RE ALWAYS IN . . . AND THE WELCOME MAT'S OUT

We always take it for granted that if you are going to be in the vicinity of our plant you'll phone or drop us a line so we can invite you to visit us. You'll find that our factory in Bethlehem, Pennsylvania, is on many well-travelled routes, and that our steam laboratory has much to offer in interest and helpfulness. Forgive us for being immodest, but the lab is the most up-to-date of its kind in the country.

When you visit us, don't allow yourself to get sidetracked by the drill presses and automatic lathes. We're proud of this equipment but you've probably seen metal mutilated before, and it's our steam laboratory that's unique. We promise you a good show, and if you have any problems, bring them along. We'll solve them while you wait.

ANYONE FOR KEY CHAINS?

Need a key chain? A tiny replica of a Sarco Thermo-Dynamic Steam Trap, Type TD-50 is attached but you can always remove it if you find it too commercial. There are many things you could use these chains for. Fishing sinkers? Lengthening a light cord? Even holding keys? Anyway, if your Sarco representative is out, write in.

Pardon our monopolizing the conversation in this series of paid communiques, but we're trying our best to interest you in certain subjects that concern us both—to the point where you'll communicate.

6355

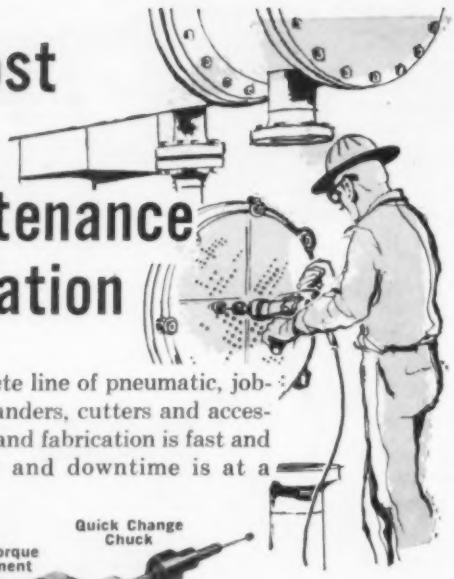
SARCO

SARCO COMPANY, INC.
635 MADISON AVENUE, NEW YORK 22, N. Y.
PLANT: BETHLEHEM, PA.

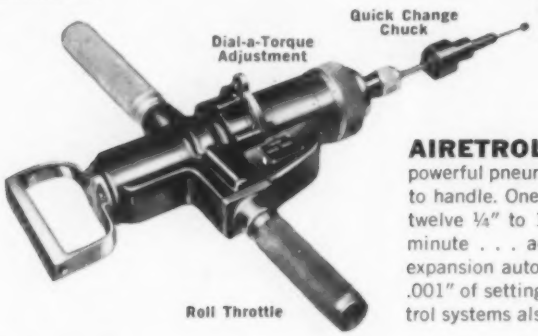
STEAM TRAPS • TEMPERATURE CONTROLLERS
STRAINERS • HEATING SPECIALTIES

For more data circle 537 on Post Card

get low-cost accurate tube maintenance and fabrication



. . . with Airetool's complete line of pneumatic, job-proven tube cleaners, expanders, cutters and accessories. Tube maintenance and fabrication is fast and accurate. Costs are low and downtime is at a minimum.



AIRETROL . . . compact, powerful pneumatic motor, easy to handle. One man rolls up to twelve ¼" to 1½" OD tubes a minute . . . accurately. Stops expansion automatically within .001" of setting. Electrical control systems also available.

CC-475 CONDENSER TUBE CLEANER . . . typical of Airetool's wide range of pneumatic geared and direct drive cleaners. Lightweight, less than 10 lbs., easy, one-man operation. Powered to clean the hardest scale and deposits. Built-in flushing system removes chips, cools bit.

TUBE CLEANERS . . . full selection of motors and cleaning heads for every type tube . . . straight or short bend. Flexible shaft and universal joint for easy operation.

GRINDERS . . . and Airetool also produces a complete line of vertical and horizontal air-powered grinders for snagging, buffing, wire wheel work, sanding and all types of grinding.

For complete information and demonstration, call your Airetool representative today . . . or write us direct.

AIRETOOL
MANUFACTURING COMPANY
SPRINGFIELD, OHIO

Representatives in the principal cities of the free world

OVER 30 YEARS' EXPERIENCE IN PNEUMATIC TOOLS

For more data circle 538 on Post Card

University. Colored a vivid orange and white, the pole is actually a new A. O. Smith smokestack which is being erected as part of the new power plant on the university campus near the Purdue University airport.

The colors may not blend with the university's traditional gold and black, but they do conform with Federal Aviation regulations which call for smokestacks of certain dimensions in the vicinity of airports to show alternate "bands of aviation surface orange and white."

ORDERS for two steam turbine-generator units amounting to a total of $4,650,0000 have been received by Allis-Chalmers. The contracts are for a 71,000-kw unit for the City of Pasadena, Calif., and a 60,000-kw unit for the City of Springfield, Mo.

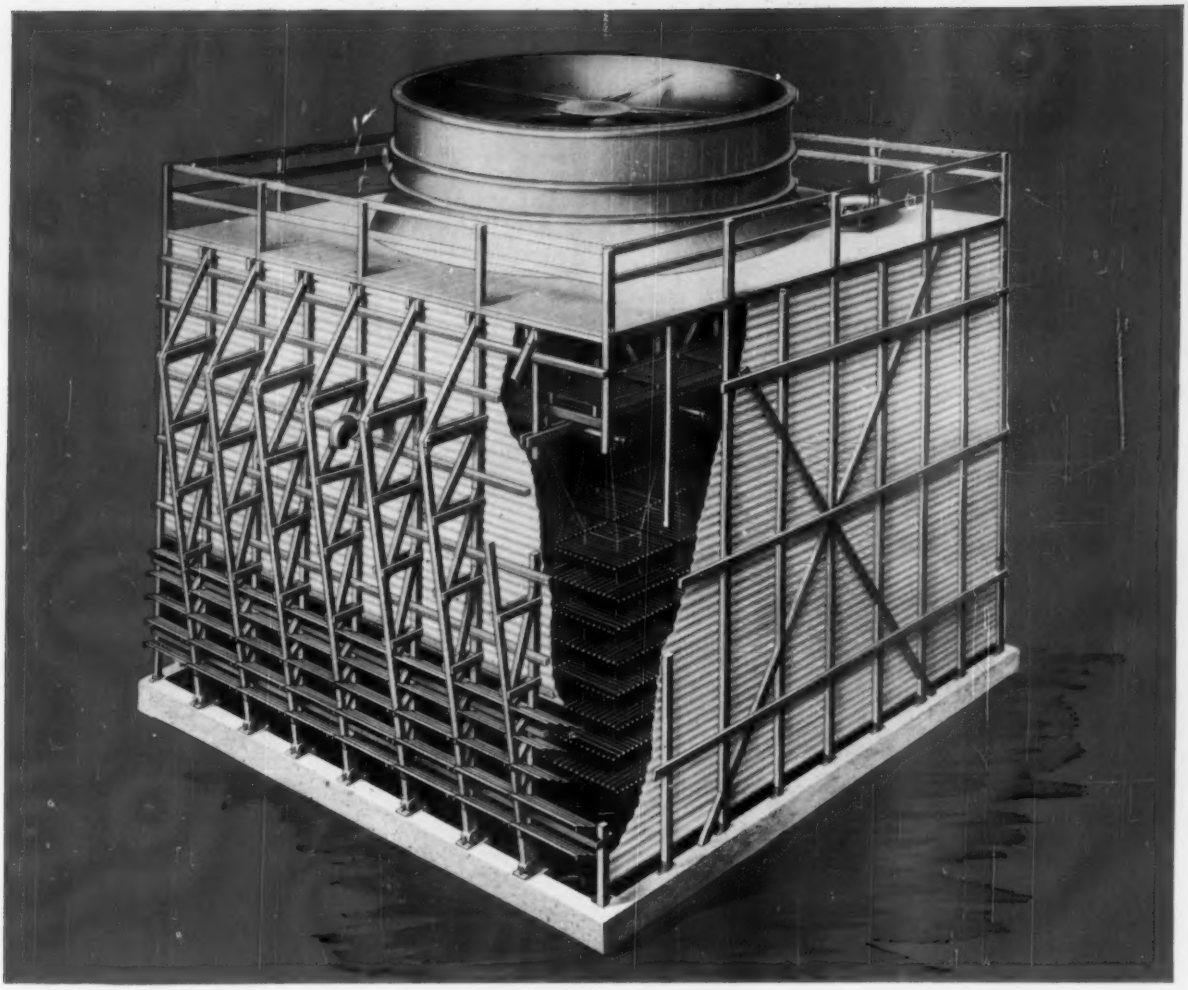
TVA will use two digital computers to control its Paradise Station units 1 and 2, near Drakesboro, Ky. The computers, supplied by TRW Computers Co., will be used in conjunction with combustion control equipment being supplied by Republic Flow Meters Co.

The system will automatically control the turbine-generators, sequence monitor the steam generators, and will sequence cold start, hot restart, normal shutdown, or emergency shutdown of the units. In addition, the system will perform sensor scanning and alarm monitoring, data logging, trend recording and performance calculations.

Paradise Station will produce a total of 1,300,000 kw of power.

$170-MILLION Fryingpan-Arkansas Project of the Bureau of Reclamation, now being considered, contemplates construction of storage and water carriage works to provide supplemental irrigation water for 280,000 acres of presently irrigated land in the Arkansas River Valley in Colorado.

It also will supply water to meet expanding needs for municipal, domestic, and industrial water on both sides of the Continental Divide, reduce flood damages along the Arkansas River east of Pueblo, generate annually about 469 million kwh of hydroelectric power.



New idea...no structural internals

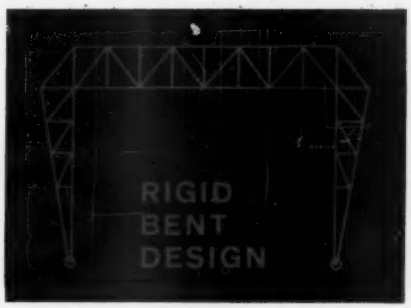
The *interior* of this new Foster Wheeler cooling tower is *completely free of structurals* below the roof trusses.

It is Foster Wheeler's new Rigid-Bent design featuring tapered built-up columns outside the tower sheathing, away from the moist, corrosive atmosphere within.

In every application, particularly where water chemistry and biological attack are serious problems, the FW Rigid-Bent design offers . . . isolation of vertical structurals from corrosion and biological attack . . . and uncommon ease of inspection, maintenance and replacement of all parts.

Space requirements and operational characteristics are the same as those attainable with older designs. Increased capacity by the addition of cells is no problem. Structurals are easily inspected and repaired during tower operation.

If you are currently considering an installation, let us provide you with further information. Write to Dept. CT, Foster Wheeler Corporation, 666 Fifth Avenue, New York 19, New York.



All tower internals are suspended from roof trusses. Cable-hung fill racks are quickly lowered to ground level for inspection and maintenance.

FOSTER WHEELER

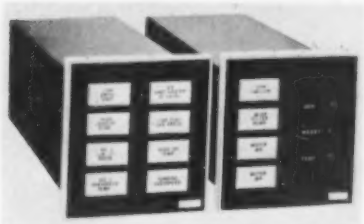
NEW YORK TORONTO LONDON PARIS MILAN TOKYO

For more data circle 539 on Post Card

Equipment News

1 — Annunciator comes in standard or miniature size

Each circuit of this solid state annunciator, by Thomas A. Edison Industries, is contained in a single channel-mounted module that plugs into a cabinet having standard or miniature nameplates. Electronic components are mounted on a rugged etched circuit board. Two sizes are available. Model



360 (shown) is a miniaturized unit ¾-by-1½-by-10-in. long, reportedly the smallest available. Two cabinets house it: the basic one has eight plug-in modules (several may be grouped for larger installations) and a similar cabinet having four plug-in modules and "acknowledge," "reset," and "test" switches. Standard-sized Model 361 is available in cabinets housing from four to 48 annunciators.

Units may be operated by a-c or d-c current; the d-c voltage obtained by a power converter. By varying external connections they may also be operated by N. O. or N. C. field contacts. The power converter contains a transistorized flasher and hermetically-sealed power relay for audible signals.

Reader Service Cards on pages 97-98 make it easy to get further product information.

3 — Torque sensor for high speed rotating machinery

Model 2302 Coaxial Torque Sensor, available from Lebow Associates, measures the torque of starters, pumps, gear boxes, and other high speed rotating machinery by restraining the case of the test device. This provides dynamic torque with frequency response by eliminating in-line sensors to change the rotating inertia of the system being tested. It can be used in any position. It is available in capacities of 200- to 2000-in. lb with ¼-per cent accuracy.

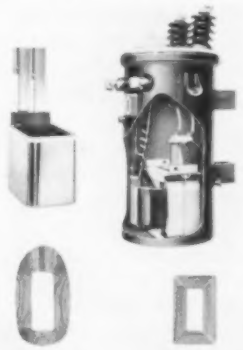
4 — Stainless steel ball valve for corrosive fluids, gases

The Lunkenheimer Co. announces a precision ball valve in Type 316 stainless steel with a choice of Teflon or Buna-N seats. According to manufacturer, the valve needs no adjustment or take-up maintenance while in service. Other features announced include self-aligning ball, straight-through flow, low-operating torque. Temperature ranges are from —20 to 400 F with Teflon seats, and —20 to 220 F with Buna-N seats. Valve is available in sizes to 2 in.

2 — Distribution transformers use aluminum strip, new type core

Design innovations announced for the DS-50 Distribution Transformers are aluminum low voltage windings and a stress free rectangular core, shown at lower right in the photo along with an older core design. Introduced by Delta Star Electric Div., H. K. Porter Co., Inc., these transformers are made with aluminum strip conductor the full width of the coil. This results in optimum magnetic balance between the two windings, manufacturer points out, and enables the units to withstand short circuit currents of more than 50 times rated current. It also means reduced weight, reduced hot spots, better regulation and longer insulation life.

The core, made possible by a new fabrication method, is designed to eliminate mechanical stress in the final form and provide maximum magnetic performance. Previously, according to manufacturer, comparable magnetic performance could be obtained only in a toroid shape unsuitable for distribu-



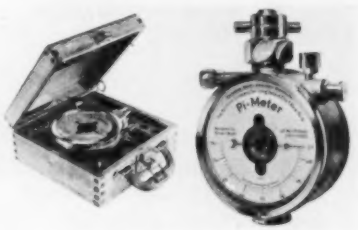
tion transformers. The new core is claimed to yield toroid performance from a rectangular configuration.

5 — Condenser performance computer reveals faults

Continuous records of condensate flow, back pressure, cooling water inlet temperature and back pressure deviation for proper evaluation of condenser operation are produced with Bailey Meter Co.'s 710 Performance Computer. It predicts optimum pressure for operating load (taking water temperature into consideration) and compares it with actual back pressure measurement. The resultant deviation indication, independent of environmental conditions, instantaneously reveals condenser fault. With condenser pressure deviation immediately available, corrective action can be taken in sufficient time to prevent forced outage. Computer is designed to record with an accuracy of ±0.05 in Hg. absolute.

6 — Performance meter simplifies balancing of engines

The Pi-Meter, introduced by The Korfund Co., Inc., permits rapid adjustment and balancing of cylinder loads and measurement of power output of multi-cylinder diesel, steam and gasoline engines. Readily installed on a cylinder's pressure tap, it reads time-averaged pressure related to indicated mean effective pressure. Five springs within accommodate a wide pressure



range for any type of reciprocating engine. Balancing loads on engine cylinders indicate when one is not providig its share of total output. With no upper speed limit (lowest limit is 80 rpm) the meter is especially useful for determining power output of high speed engines. It weighs about 9 lbs, measures 5-in. diam by 3 in and is supplied in a mahogany box with accessories, including lubricating pump.

7—Digital telemetering equipment for simple applications

Type DL digital telemetering equipment for the telemetering of kilowatt hours on electrical utility systems or positive displacement on pipelines is offered by Westinghouse Electric Corp. For each kilowatt hour or positive displacement reading to be telemetered, a contact device on the meter will feed incremental impulses into a register unit at a remote station. When a telemetered reading is required, the readout transmitter sends the reading of the register to the master station where it is indicated or logged. The equip-

CONDENSATE BY-PASS . . . DIRECT ROUTE TO IMPROVED WATER LEVEL INDICATION

Unmistakable water level readings are assured with Diamond's MP-3000 Multi-Port Bi-Color Gauge, equipped with condensate by-pass. A major reason for such performance is the unique and exclusive by-pass which traps any condensate before it reaches the port channel. The absence of condensate in the port channel assures a distinct bi-color image — red for steam, green for water. Regardless of operating pressure, there's a Diamond Gauge to provide accurate water level readings. Write for complete information or contact your local Diamond representative.

Diamond Power Specialty Corporation, Lancaster, Ohio

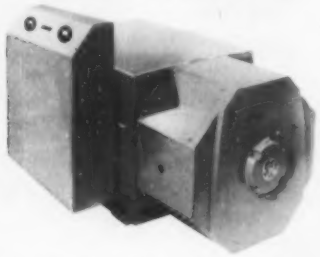
Diamond Specialty Limited • Windsor, Ontario

Diamond

ment uses telephone relays and stepping switches. Data is transmitted over any telegraphic channel in binary-coded decimal form by means of long and short pulses and spaces.

8 — Packaged brushless synchronous generators

General Electric Co. announces the Custom 8000 Series of synchronous generators, available in 1200- and 1800-rpm ratings through 350 kw, ready for connection to drivers. Incorporated into standard design are a brushless ex-

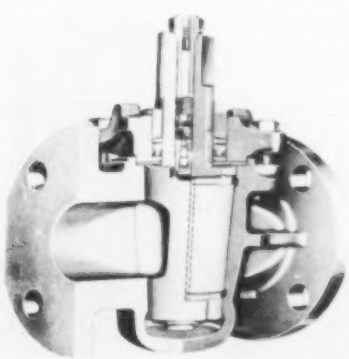


citer, static voltage regulator, ammeter and voltmeter, mounted on the set. According to manufacturer, these generators require less maintenance due to elimination of collector rings, brushes and commutators from conventional exciter and generator system.

Each generator is available with two bearings for standard coupling applications, or a single bearing with SAE adapter and flexible disc-type coupling to permit matching with diesel-engine drives. Several modifications are available.

9 — Tapered plug valve has high lubricity plastic coating

Rockwell Mfg. Co.'s Permaturn Valve has a high lubricity plastic coating said to reduce turning and provide maintenance-free operation. It is designed for a wide range of services including chemicals, water and sewage. For pressure to 1000 psi the coating is Teflon. Phosphate-molybdenum disulfide coats those for pressure to 10,000 psi. Two other features help reduce maintenance. One is a fixed adjustment assembly on low pressure valves for a constant tight seal after



repeated openings and closings. The second is a threadless stem that reduces high operating torque. Additional features are single, quarter-turn operation, and easy seat replacement by injection of sealant through a button-head fitting while unit is operating.

Models are available in ¼- to 36-in. sizes in standard pressure ratings. For pressures to 1000 psi WOG it is made in standard design. For pressures from 1000 to 10,000 psi WOG, the inverted Hypreseal is suggested.

10 — Insulating cement withstands higher temperatures

BEH No. 1 Plus Insulating Cement has an increased effective temperature range to 2100 F with no increase in cost, according to Baldwin-Ehret-Hill, Inc. The material is also said to be whiter and easier to handle than the 1800 F mineral wool insulating cement it replaces. Reduction in nodule size of mineral wool results in greater smoothness and uniformity.

11—TEFC motor with aluminum air-to-air heat exchanger

Totally Enclosed d-c Motors in the Life-Line H series of Westinghouse Electric Corp., feature a new heat exchanger in ratings of 75 to 250 hp at 1150 rpm. Generators in corresponding rates are available. An internal blower pulls hot air from inside the motor

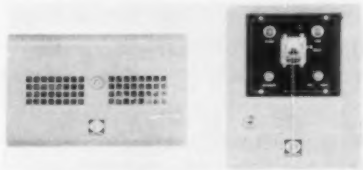
through the ducts, while an external blower pulls air over the ducts and discharges air through the dripproof front end of the exchanger. An a-c totally enclosed vertical motor is recessed in the d-c motor commutator bracket to reduce the height of the 75- and 150-hp units to 32½ and 35¾ in., compared to 44 and 52 in. of conventional designs. Less maintenance, even in dustiest atmosphere, is claimed.

12—Noncorrosive algae inhibitor for nonpotable water systems

Used in cooling towers, air conditioning systems and other similar applications, Formula D-130, by The Bird-Archer Co., kills and prevents algae growths. Supplied in concentrate form, it may be added to systems at different feed rates. Composed of a mixture of chlorinated phenolic compounds, it contains no mercury, copper or iodine and is said to be compatible with water treatment chemicals.

13—Electronic fence detects approach of intruders

Radi-Matic Barrier is designed by The Powers Regulator Co. for perimeter security of storage depots, and similar large areas. Operating on low frequency, it transmits an electronic wave to detect approach of intruders. Any attempt to crawl under, cut through or climb over this antenna



array is instantly detected and reported to monitor located remotely in guard office, police station or other center. Antenna is zoned into sections to pinpoint location of attempted intrusion. System is installed alone, onto existing fence or adapted to rows of multipane windows. It is unaffected by weather conditions, line voltage fluctuations or nearby electrical equipment. Circular 366D describes transistor (shown left), monitor (right) and antenna.

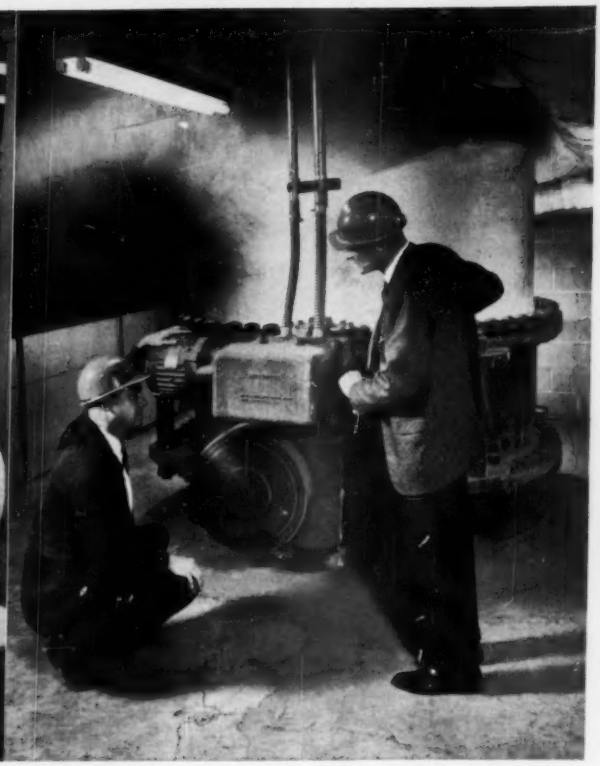
14—Power roof ventilator with easy-access top

Entire motor and fan housing of the Flip-Top Power-Flow Roof Ventilator tilts back 90 deg to make motor, drive and fan easily accessible at a convenient working height above roof level.

Unit is produced by DeBothezat Fans Div., American Machine & Metals, Inc., with fan wheels to 48 in., capacities to 43,070 cfm. Bulletin DR-7-61 gives specifications.

15—Capacitors for ultra high voltage applications

These capacitors are introduced by Corson Electric Mfg. Corp. for ultra high voltage d-c filtering, X-ray, nuclear accelerators, betatrons, pulse net-



From blueprint to installation...

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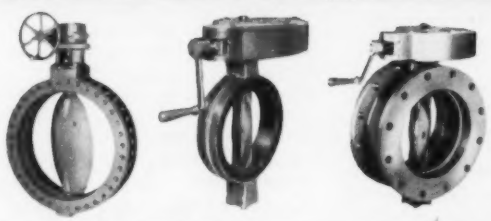
Henry Pratt products are engineered on the basis of long experience in the power industry... this is the reason why so many power plants use Henry Pratt valves and related equipment. With over fifty years of experience as a power industry supplier, Henry Pratt can make real contributions in engineering, and by saving space and costs. Add to this a field engineering staff that goes anywhere any time, and you get with these products a service that is unmatched for know-how and follow-thru.

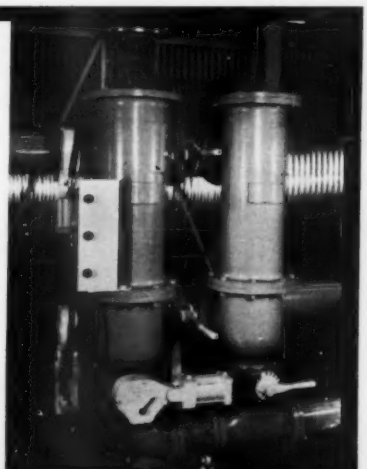


RUBBER SEAT BUTTERFLY VALVES . . . BUBBLE TIGHT

The RIA valve above offers the smallest face-to-face dimension for service to 100 psi of any comparable valve. In sizes from 24" up. Comes also in combination with space-saving expansion joint for condenser water circulation.
Catalog B-3G

Monoflange and 2FII valves are wafer and flanged type in sizes from 3" thru 20". Pressures to 150 psi. Offer space savings and rugged dependability for many jobs. Wide variety of Manual Automatic Operators.
Catalog B-11G

CYCLONE STRAINER
Unique new strainer utilizes a powerful swirling action—keeps larger particles from basket and forces them toward trash outlet. Stays on line longer, requires less cost and maintenance than similar units. Compact multiple units save space, meet any flow requirements or pressure drop. Back-washing with auto or manual controls.
Catalog S-1G



HENRY PRATT®

Creative Engineering for Fluid Systems

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works, radar and high voltage test equipment. Rectangular, Bakelite tube design and triple dielectric construction reduces volume of capacitors, and serves to eliminate Corona problems. Capacitors are designed for d-c operation at 60 C for 10,000 hr; may be used to zero C. Nine ranges available from 50 to 250 kv d-c Bulletin 105 gives details.

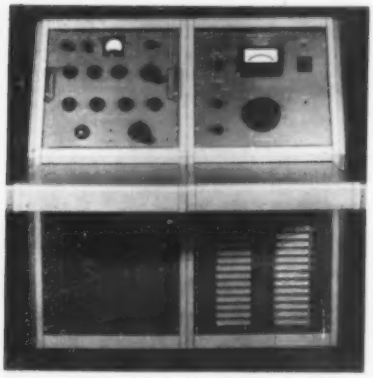
Described on these pages are new and improved products. Use Reader Service Cards on pages 97-98 to ask for more information on them. Just circle item numbers of products in which you are interested.

16 — High-strength refractory has low gunning rebound

Designed by The Babcock & Wilcox Co. for wet or dry pneumatic gun placement with low rebound loss and minimum dusting, Kaogun-HS Castable produces a high strength monolithic body with outstanding resistance to abrasion and thermal shock. With a recommended use temperature of 2500 F, the castable refractory is suitable for ashpits, stacks, incinerator doors, ash hoppers, flues, boiler furnaces, dust collectors and settling chambers, catalyst carrying lines, by-pass stacks in CO boilers and seal tanks, and as a rear wall seal on traveling-grate furnace. Pre-dampening with 1 qt of water per bag reduces dust generation while dry gunning. Wet gun applications require about 6 qt of water.

17—Capacitance bridges feature direct reading, accuracy

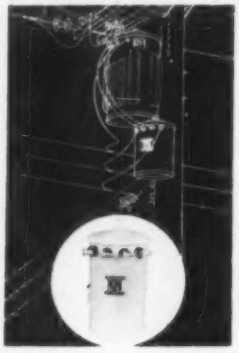
High voltage capacitance bridges offering fast operation, accurate, direct readings and built-in performance check are announced by General Electric Co. Units are available in mobile



or stationary consoles to 500 kv plus. An accuracy of capacitance measurement of 0.2 percent and dissipation factor measurement of 0.01 percent is announced. Designed to measure capacitance, dielectric losses and dissipation factor of insulation and insulated apparatus — bushings, power cable, transformers, generators, motors and switchgear—while insulation is stressed at operating voltage. A transistorized null detector is included.

18—Automatic voltage regulator for use on secondary lines

Unoreg is a 2½ kva self-contained automatic voltage regulator designed by Westinghouse Electric Corp. for use on the low-voltage side of over 600 standard distribution transformer styles



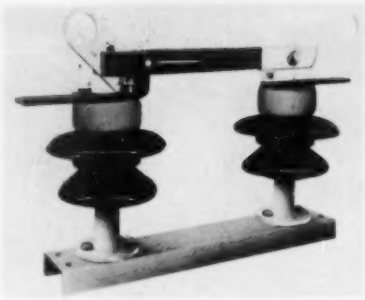
through 50 kva. Compact, lightweight for convenient pole mounting, Unoreg consists of an induction regulator controlled by a solid-state voltage regulating control with no moving parts or contacts. It provides plus and minus 5 per cent regulation of 120/240-v secondary lines. Major applications include bucking raised secondary voltage of individual distribution transformers located at head end of feeder, and boosting secondary voltage of individual transformers at or near the end of a long or heavily loaded feeder.

19 — Multi-acid removes rust down to bare metal

Aci-Gel is a multi-acid material which removes rust to bare metal by chemical action, at a fraction of the cost of wire-brushing, blast cleaning and flame cleaning, according to Sloan Chemicals, Inc. It brushes on, flushes off with water, leaving a clean surface for painting. Suspended in a thixotropic gelling agent, the material clings to vertical surfaces and will not sag.

20 — Air switches have silver contacts for longer life

The solid silver contacts of the AgH Air Switches, a line of hook-operated air switches introduced by Federal Pacific Electric Co., provide longer life and added reliability. Switches are available in ratings of 7.5 kv to 34.5 kv, 400, 600 and 1200 amps and momentary ratings of 20,000 and 40,000 amps. Contruction is in accordance with NEMA, ASA and AIEE stand-



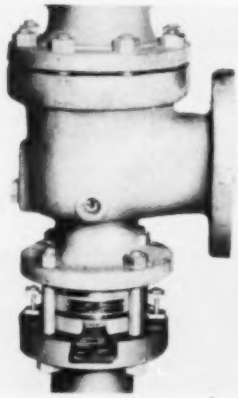
ards. They come in two types: single-pole single-throw and single-pole tandem transfer. Widely-spaced parallel blades provide a rigid blade unit.

21—Epoxy impregnated glass cord for electrical lashing

Type XP-205, Scotchply, a reinforced plastic, of Minnesota Mining and Mfg. Co., is impregnated with an uncured high temperature resin to prevent glass abrasion and weakening during handling, and thermo-sets for extra toughness and easier bonding. Currently used as a string band on large commutators, it is wrapped with a tension of 20 to 30 lb and coated with a suitable thixotropic resin, then cured. The coating gives a smooth surface that does not collect dirt, carbon or grease. Other applications include tying motors, generators, and as substitution for untreated glass cord. It has a resin content of 26 per cent, ±3 per cent, tensile strength of 100 lb before curing, 210 lb after, an arc resistance of 120 sec. Self-extinguishing, it has a shelf life of three months at 70 F up to 12 months at 40 F.

22 — Compact safety heads are installed underneath valves

Quik-Sert Safety Heads, introduced by Black, Sivalls & Bryson, Inc., contain a rupture disc to protect vessel or system from overpressure. They are designed to nest inside the studs of standard ASA flanges and can be installed underneath a safety or relief valve, eliminating normal vapor losses through the valve. Preassembly of



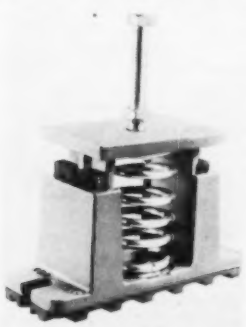
rupture disc away from location affords installation conveniences and isolation of valve reduces maintenance.

23—Pocket-size insulation tester always ready for use

Mark III Megger Insulation Tester, with its constant voltage hand generator, provides steady testing voltage without dependence on batteries or other current supply. Manufacturer, James G. Biddle Co., announces availability of three ranges: 100 v d-c, 0.02-20 megohms; 250 v d-c, 0.05-50 megohms; 500 v d-c, 0.1-100 megohms — each with double scale and selector switch for 0-10,000 ohms. An optional leather case protects in severe field service; the leads store in a compartment under the set. Bulletin 21-85-24 describes the Mark III.

24 — Strong mounting stops noise, structural shock

Type LNAA Mounting, an isolator utilizing a single helical coil steel spring as the cushioning medium is introduced by the Shock & Vibration Div., The Korfund Co., Inc. It is claimed to cut equipment installation time 50 per



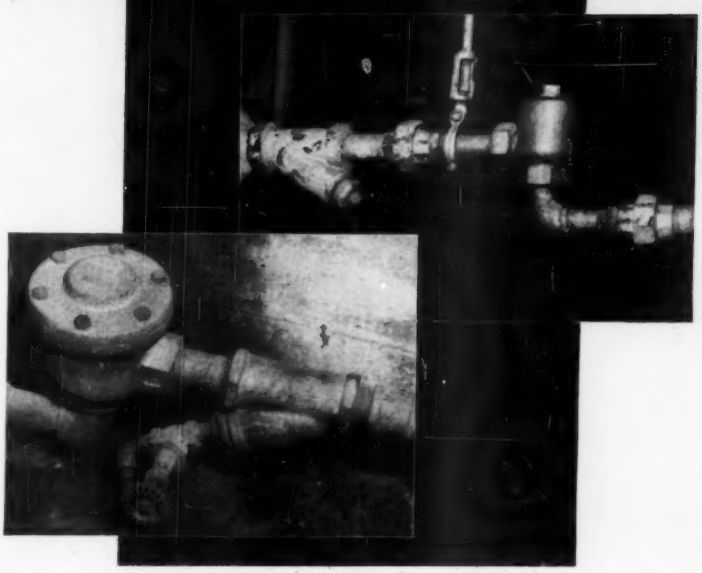
cent, maintain machinery efficiency and stop vibration and noise transmission from fans, cooling towers, motor generators, furnaces, turbines etc. A selection of four springs, for insertion into the isolator housing, provides a load-carrying capacity range from 50 to 540 lb. Its cast semi-steel housing is compactly built, and has an access port on each side for interior inspection, cleaning, and changing springs without dismantling. An external leveling device eliminates need for shims, and soft rubber snubbing chocks restrict lateral movement.

25—Load break switch features design improvements

An improved version of the V-2LB, sulphur hexaflouride (SF_6) outdoor load break switch (VLB), is available from Westinghouse Electric Corp. The basic VLB SF_6 interrupter with modified paralleling auxiliary blade has been added. The interrupting ability of the V-2LB is 600 amp of load current at 50 per cent power factor in voltages of 15 through 138 kv. In addition, it

Consider These Facts about **THERMOSTATIC TRAPS**

TO ASSURE HIGH EFFICIENCY AND LOW MAINTENANCE



Every trapping requirement cannot be met with one trap. Consequently Anderson manufactures a complete line of traps including the remarkable Quik-Flex Thermostatic Steam Trap. From one source you can meet all your trapping needs. If you are using or planning to use thermostatic traps, consider these important facts—features built into every Anderson Quik-Flex Trap.

- **Large capacity covering a wide pressure range simplifies specifications.**
- **Only one moving part assures low maintenance and less downtime.**
- **Fast heating up of units through quick discharge of condensate and/or air.**
- **Guaranteed freeze-proof when properly installed and operated for outdoor operation.**
- **Compact design permits simplified piping in hard-to-get-at places.**
- **Immediate delivery is guaranteed from inventory.**

Write FOR COMPLETE INFORMATION AND BULLETIN 257 DESCRIBING THE ANDERSON QUIK-FLEX THERMOSTATIC TRAP.

SUPER SILVERTOPS STEAM TRAPS
BY THE MANUFACTURERS OF Hi-eF PURIFIERS

THE V. D. ANDERSON COMPANY
Division of International Basic Economy Corporation
1997 West 96th Street • Cleveland 2, Ohio

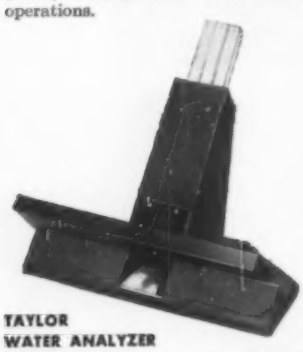
For more data circle 544 on Post Card

I GOOFED!

(I didn't buy a Taylor Comparator the *first* time.)

I thought comparators were pretty much the same, but was *I* wrong: Broke two of those fragile, individual glass standards the first week . . . and things were really fouled up. Got a Taylor Comparator as soon as I could . . . and I'm really sold on Taylor. You can't beat a slide with the color standards right in it for convenience and easy use.

Taylor Comparators—with guaranteed non-fading color standards in a single slide—let you make fast, easy, accurate tests for pH, phosphate, chromate, sulfite, hydrazine, nitrate, etc. . . . right on the spot. You get dependable data to help you control boiler, condenser or water tower operations.



TAYLOR WATER ANALYZER

For colorimetric water analysis: Also available—Taylor Comparator, Model T-3 for long range pH tests. Color standard slides cover the 3 to 9 pH range.

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SEE YOUR DEALER for Taylor Sets or immediate replacement of supplies.

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handles transformer magnetizing current to 100,000 kva banks at 138 kv and single capacitor banks to 10,000 kvar at 138 kv.

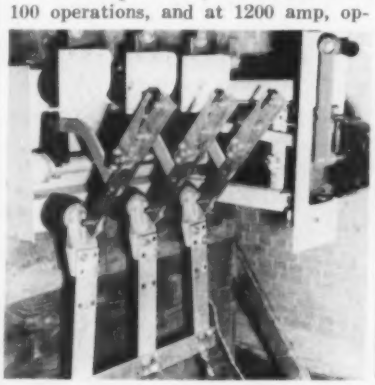
26—Safety hats molded of high impact thermoplastic

Injection molded of polycarbonate thermoplastic, Shockgard Mark II Hats and Caps by Mine Safety Appliance Co. combine high impact and penetration resistance with superior dielectric properties. High dielectric

strength is said to be retained even under severe impact, and temperatures from —100 to 270 F. Lightweight, with single ridge construction, hats also offer high resistance to chemicals, acids and alkalis. Fixed crown suspension features double cradle design, and critical crown clearance—at least 1⅜ in.—is tamper proof. Upper cradle is fixed permanently while lower cradle adjusts to wearer's comfort. Hats come in nine molded-in colors.

27 — New type load break switches for fault closing

Fault closing ability of LBF-2 Load Break Switches is 60,000 amp at 5 kv and 40,000 amp at 14.4 kv. Available from Westinghouse Electric Corp. in ratings 5, 7.2 and 14.4 kv, these switches open 600- or 1200-amp load current at 80 per cent power factor and handle transformer magnetizing current in addition to small capacitive currents. At 600 amp the interrupting life at 5 kv is 500 operations, at 14.4 kv it is 100 operations, and at 1200 amp, op-



PALMER

Mercury Actuated Dial Thermometers now in three types to suit any requirements

PALMER
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PATENTED
FULL 4½" DIAL FACE. Stem can be placed at any angle and case can be rotated to any readable position.
1 RIGID STEM DIAL THERMOMETER tapered bulb, interchangeable with standard industrial thermometer separable socket. (As illustrated above.)
2 WALL MOUNTED DIAL THERMOMETER with flexible connecting armor. Case adjustable to easy reading position.
3 FLUSH MOUNTED DIAL THERMOMETER for panel mounting with flexible connecting armor.
ALL THREE TYPES HAVE A FULL 4½" DIAL FACE.

■ **for accuracy:** Mercury actuated . . . Compensated by Invar. Guaranteed Accurate 1 scale division. ■ **for angularity:** Can be adjusted to most readable position at any angle desired. ■ **for readability:** Bold Black Numbers . . . 11" of scale Reading Dial face can always be placed in easiest readable position. ■ **for interchangeability:** Also specify "PALMER" Separable sockets as they are interchangeable for Dial or Industrial type Thermometers.

PALMER

PALMER THERMOMETERS, INC.
Norwood Ave., Cincinnati 12, Ohio
MFRS. OF INDUSTRIAL LABORATORY, RECORDING AND DIAL THERMOMETERS

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erating life is 20 interruptions before maintenance is required. Unitized assembly consisting of pole units, mounting frame, spring operating mechanism, and operating handle may be mounted in its own enclosure or in a metal-clad switchgear.

28—Low-range oxygen analyzer has dual-range design

Model 632C, an explosion-proof oxygen analyzer for gas mixtures, introduced by The Hays Corp., has versatile, dual-range design (0-1 to 0-10 per cent) permitting tracking while process is brought into range, providing precision analysis (±2 per cent) under normal operation. It is unaffected by hydrogen or other hydrocarbons. With a built-in indicator no external receiver is required; any disc receiver meeting specifications may be used.

The analyzing cell consists of a gas passage, a glass cross member, and inlet and outlet pipes. Oxygen-bearing gas is drawn into a field and heated, cooling the winding. Cooler, more magnetic gas is then drawn in, forcing the previously warmed gas past another winding, cooling it to a lesser degree. The temperature difference is interpreted as percent oxygen. Failure in the upper electronic or lower measuring unit is isolated by built-in switch.

29—Practical preheat systems for welding alloy steels

"Building block" strip-heater systems for welding high performance steels, introduced by J. B. Nottingham & Co., Inc., consist of Duraline unit heaters fitted end-to-end to preheat a weld area of any length, a suitable temperature control, and plug-in cables and connections for distributing power to strip and pipe heaters. Weldments of almost any size or shape, including pipe down to 3-in. diam., may be heat treated. Welders may work while heaters are in operation, automatically holding parent metal at pre-set temperatures. Personnel and equipment are protected by built-in fuses, equipment-grounded circuits, and molded Neoprene-insulated construction.

Reader Service Cards on pages 97-98 make it easy to get further information on any of these products. Just circle the item numbers of the products you want to know more about.

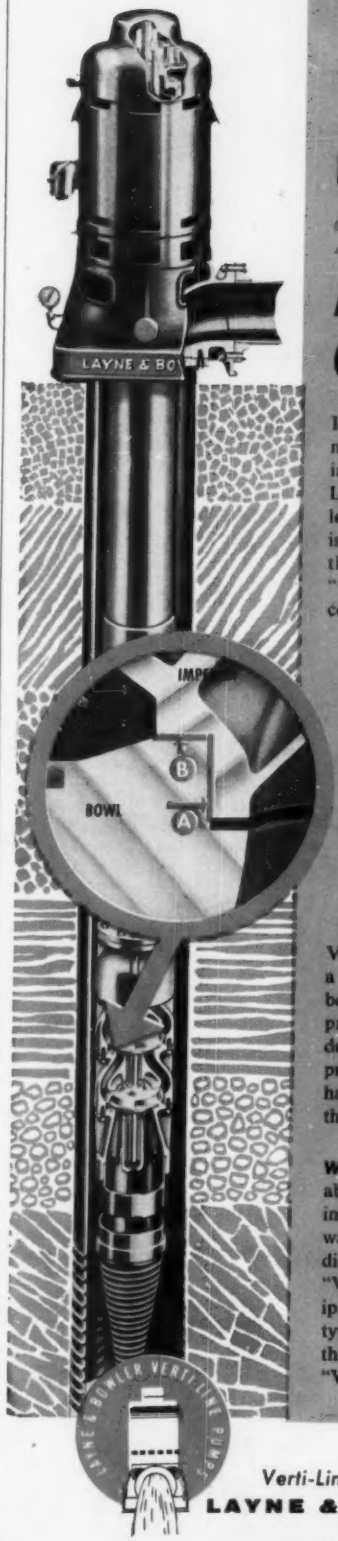
30—Selenium rectifier features simplified control

Designed by Westinghouse Electric Corp., this selenium rectifier 500-600 amp power source provides relative flat volt-ampere required for maximum arc stability. It features open-circuit

Still Another Reason You're Far Ahead With...

Verti-Line Pumps

Unique "PERIHEDRAL" 2-WAY Pump Seal ASSURES GREATER OPERATING EFFICIENCY!



If you think all vertical turbine pumps are pretty much the same, you haven't investigated the important "plus" advantages built into every Layne & Bowler "Verti-Line" Pump. Tougher, longer-lived "Moly" Iron *at no extra cost to you* is one vital "Verti-Line" advantage. Another is the larger-than-standard pump shafting in "Verti-Line" Pumps for greater resistance to costly "twist-offs."

And still another is the unique "Perihedral" Pump Seal found only in Verti-Line Pumps. This seal combines both *vertical* and *horizontal* sealing surfaces between each pump bowl and its impeller.

The vertical sealing surface "A" permits shaft stretch under load without losing the pump seal.

The horizontal sealing surface "B" permits accurate adjustment *at ground level* to compensate for wear. Saves time, simplifies maintenance, assures full operating efficiency without complicated adjustments!

Vertical Turbine pumps are the ideal solution to a wide range of modern pumping problems because they save costly floor space, require no priming, are generally simpler to install. But don't be satisfied with *ordinary* vertical turbine pumps. Specify "Verti-Line" Pumps and get the half-century of vertical turbine pump know-how that is built into *every* Layne & Bowler unit.

Want More Data? "Verti-Line" Pumps are available in a complete range of sizes to fit all types of industrial applications, from deep-well primary water supply to close-coupled booster or waste disposal applications. Also, laboratory-approved "Verti-Line" Fire Pumps are available for municipal and industrial fire protection. Tell us the type of pump you need and we'll send literature that describes the *extra* advantages you get in "Verti-Line" equipment.

Verti-Line Pumps are the exclusive products of

LAYNE & BOWLER PUMP COMPANY
LOS ANGELES 22

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Farwell, Texas • Twin Falls, Idaho • Fresno, Calif.

For more data circle 547 on Post Card

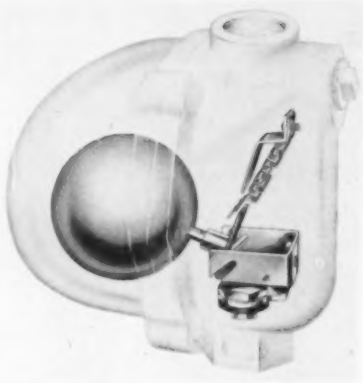
voltage control, weatherproof construction and de-ion life-linestarter welder control. Welders may be parallel or series-connected for current or voltage required. A 1-kva auxiliary transformer and two outlets to supply 110-v, 60-c single phase power is standard.

31 — Transformers are redesigned for greater mobility

Easier station change-outs and longer service life are announced for General Electric Co.'s redesigned power transformers. Moving is simplified because tank height has been reduced from over 15 to 12 ft, and weights have been cut 10 per cent. Transformers on highway trailers can pass under bridges with 14-ft clearance. Reductions in length and width cut floor space requirements, and existing transformers can be replaced with higher-rate units without extensive rebuilding. Permalex insulation is standard. When operated at 55 C, transformers have greater overload capabilities. Insulation also permits 65 C continuous operation at 12 per cent higher kva capacity with no loss of life.

32 — Thermostatic steam trap has rugged bi-metal control

Equipped with a stainless steel thermostatic air vent, the Float Thermostatic Steam Trap by Mil Div., Farris Engineering Corp., provides continuous discharge of condensate and air, shuts tightly on steam to prevent waste. Its rocker design simplifies mechanical linkage, allows greater compactness. In-line inspection is accomplished by removing the body housing. Connections are for ¾-in. pipe. Three pressure ranges are avaliable: from 0 to 30, 75 and 150 psi. Catalog FE-310 gives information.



33—Control computer features wide range of capabilities

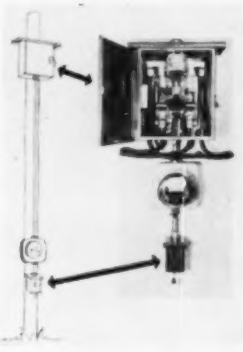
Flexibility and high performance are features of the RW330 Control Computer by TRW Computers Co. Initial investment of the system can be limited to requirements of an application, and later expanded to meet additional requirements. Its flexible memory capacity can be supplied in a range from 4,000 to over 100,000 words. The basic command structure (to which special commands can be added) and a 28-bit word length contribute to the machine's high performance. Addition instruction are performed in 260 microseconds; typical programs run at 600 to 1200 operations per second.

34—Close-coupled fhp unit for low-cost pumping

Model C-15-Type RHK is designed by Allis-Chalmers Mfg. Co. for handling clear non-corrosive liquids at temperatures to 180 F. Available in range through 48 gpm with heads to 100 ft, the cast-iron, single-stage, single-suction pump has enclosed Delrin impellers and screwed connections. Compact construction and lower weight are achieved by mounting pump parts on motor and using motor end housing as pump stuffing box cover. Units can be installed horizontally or vertically by bolting motor feet to a suitable support. Casings have centerline discharge, are self-venting and can be rotated to any of four positions 90 deg apart. Motors are standard NEMA, rated ½ through 1 hp, in single and three-phase construction at 3450 rpm.

35 — Metering switch protects transformer from overload

The' Meter-Rite by System Analyzer Corp., provides cold load pick-up protection after power failures, and transformer protection from overload and short circuits and also permits use of old meters when increasing power output. It is announced as competitive in price to a 200-amp meter loop and less costly than a conventional 400-amp meter loop. The switch is mounted at the top of the meter pole with control breaker (standard equipment) mounted directly below. A current transformer, protected by a built-in circuit breaker, permits metering accuracy equal to a meter loop using a standard current transformer and low amperage meter. A thermal time-delay switch mounted in a weather-tight assembly box protects the electrical system during power



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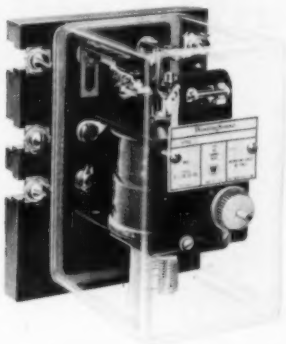
outages or failure. When power demand becomes excessive, or short circuits occur, the breaker disconnects automatically. A remote control breaker switch is at the bottom of the meter pole within easy reach.

36 — General purpose relays are front connected, glass-cased

Westinghouse Electric Corp.'s Type SC and SV Relays are used as fault detectors to supervise main protective relays, or prevent damage to motors from high current or low voltage under



normal conditions, where time-delay relays would not operate fast enough. They can be used on d-c and 25- to 60-cycle a-c without coil changeover. Base design makes terminals (and connection to contacts and coil) available from the front, permitting flat mounting. Operating elements are instantaneous plunger type providing one-cycle operation at two times pickup on a-c, adjustable over entire range and set for specific value of pickup.

37 — Monitor continuously checks on line voltages

Model VW-120A Monitor, by Radio Corp. of America, responds continuously to fluctuations and changes in power-line voltage. It is intended to overcome problems of high and low line-voltage in electronic servicing, eliminating false indications and damage to equipment. Monitor has an expanded scale from 100 to 140 v, and a moving-vane type meter designed to indicate true RMS values even when line-voltage is not pure sine wave. High accuracy reading, wide frequency range from 25 to 400 cps, fast meter action that reveals fluctuations and "bounces" in line-voltage.

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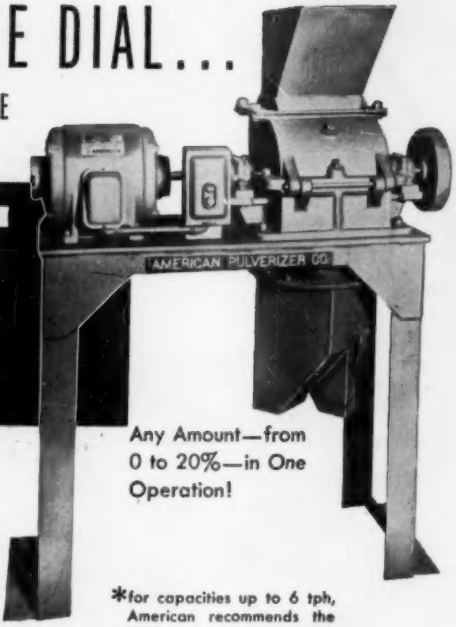

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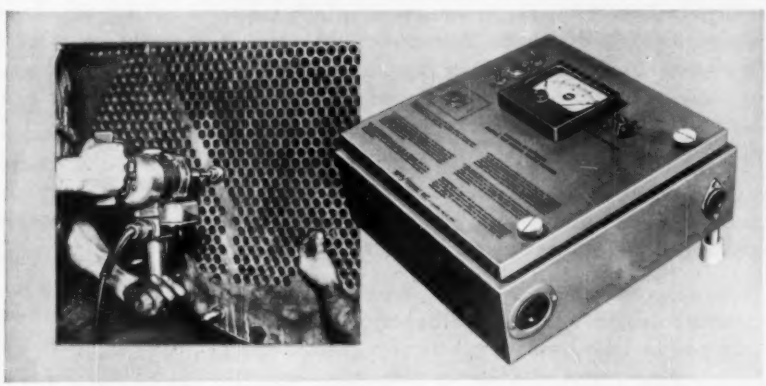

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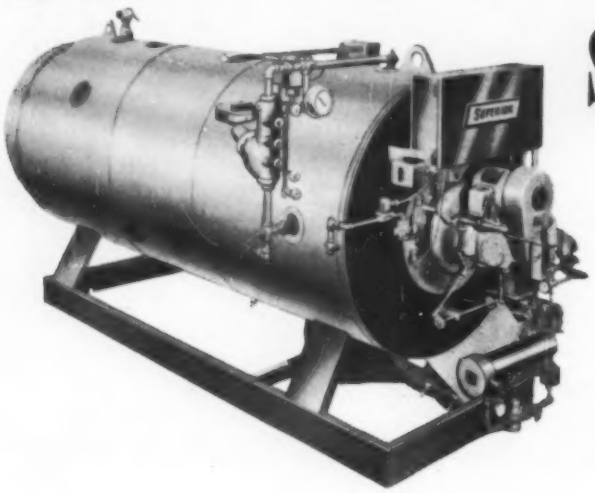

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Reference File of Commercial Literature

Motive Power

201 Gas Turbines—The power concept of The Cooper-Bessemer Corp.'s gas turbine based on the J-57 jet engine is discussed in 8-pp Bulletin 95. Describes operating characteristics, thermal efficiencies, maintenance costs.

202 Industrial Gas Engines — Advantages and economies of industrial gas engines made by Orenda Engines Ltd. for general industrial and other applications are outlined in this 24-pp bulletin. Performance data and curves, dimensions, operating costs curves.

203 Industrial Gas Turbines — Versatility of General Electric Co.'s gas turbines as a power source for a variety of industrial and other applications, including power for emergency generator sets, is detailed in 16-pp Bulletin GED-5685.

204 Gas Turbine Power—Eight-pp Bulletin GEA-7083 of General Electric Co. introduces a line of 75 to 20,000-hp ultra-lightweight, compact gas turbines for a wide variety of applications, including fluid and gas pumping, electric power generation.

205 Gas Turbine Engine — Saturn T-1000, an industrial gas turbine engine manufactured by Solar Aircraft Co., weighing 1200 lb and rated 1100 hp, is detailed in Bulletin T-1000. Advantages, performance data.

206 New Look in Gas Engines — Bulletin 205 discusses two-cycle gas engines, emphasizing performance characteristics in variable-speed, variable-load applications. Constant pressure turbocharging and ignition timing control, and advantages of each are explained; performance curves provided. Bulletin is offered by Clark Bros. Co., Dresser Industries, Inc.

207 Self-Contained Power Plant—A "workhorse" gas turbine package power plant (rated 11,250-kw peak) is introduced in 16-pp Bulletin GED-7217A of General Electric Co Basic operating conditions are detailed, and use for peaking, emergency standby, end-of-line power covered. Describes power unit, generator, tailor made accessories; stresses economy, reliability, flexibility. Enclosed supplementary booklet discusses electrical arrangements, gives further data.

208 Solid-Wheel Turbines — Principle of operation and advantage of solid-wheel turbines designed to operate with minimum maintenance are detailed in 16-pp Bulletin S-159 by The Terry Steam Turbine Co. Dimensional data included.

209 Large Generating Units — Design and construction features of large steam turbine generating units are illustrated and described in 40-pp Bulletin 0.3B9448, Allis-Chalmers Mfg. Co. Subjects covered range from compact component design to controls and instrumentation. Includes ratings.

Dust Control

210 Dust Collection, Recovery — Details on dust collecting, recovery and classifying equipment manufactured by Buell Engineering Co., Inc. are presented in this product bulletin. Covers electric precipitators, mechanical collectors, bag collectors.

211 Dust Collecting Equipment — Product data on dust collection, precipitation and gas scrubbing equipment covers electrical precipitators, mechanical dust collectors, others. From Western Precipitation Corp.

212 Electronic Air Cleaner—Twelve-pp Bulletin 405, Dollinger Corp., describes features and advantages of an electronic air cleaner based on the principle of electrostatic precipitation. Diagrams, photos, specifications included.

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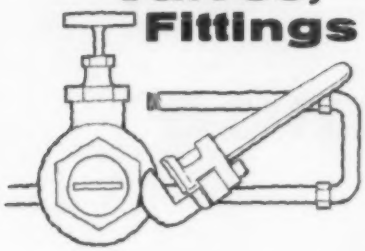

213 Valve Guide — Catalog 800-A contains 20 pp of detailed information and technical details on company's bronze valves, as well as pressure and temperature controls, solenoid valves and strainers. Includes descriptive data, comparative chart, estimated weight tables by Detroit Controls Div , American-Standard.

214 Ball Valves — Comprehensive information on manual and pneumatically operated ball valves in sizes from ¼ through 12 in. is given in 32-pp Catalog 1200 by Hills-McCanna Co. Includes diagrams illustrating design features, dimensions and weights, rating charts.

215 Valve Guide—Globe and angle, gate, check and other types of valves in bronze, iron, steel and alloys, are catalogued in 24-pp Form 232 of The Wm. Powell Co. Provides selection information, including application suggestions, features, ratings.

216 For Power, Industrial Plants—Catalog 14, 91 pp, Edward Valres, Inc., describes cast and forged steel valves for power, petroleum, chemical and industrial applications. Provides dimensions, pressure-temperature rating and baic materials specifications, as well as curves and formulas for correlating valve size and pressure drop.

217 Silent Check Valves — Results of pressure loss tests conducted on flanged silent check valves of The Williams Gauge Co., Inc. are presented in tabulated Bulletin WH 659, along with pressure drop information.

218 Improved Butterfly Valves — Details on butterfly valves with adjustable rubber seat features for varied requirements are presented in Bulletin 6 of The Henry Pratt Co.

219 Safety and Relief Valves — Comprehensive performance and selection information on safety and relief valves for industrial applications is presented by Manning, Maxwell & Moore, Inc. in 144-pp Catalog 700B. Includes capacity and dimension tables, on cast steel, cast iron safety and relief valves, Maxiflow safety valves, others. Available to qualified power engineers, please state your job title.

220 Valve Selection Tips—In addition to cross indexing company's own line of valves with those of other manufacturers, The Ohio Injector Co.'s Valve Buyer's Guide, 22 pp, contains a list of frequently used abbreviations, a valve trim chart, other data. A breakdown by valve material and pressure class, and classification by type, disc design included.

221 Valve Flow Characteristics — Two methods for determining flow chracteristics of Rockwel-Nordstrom valves are described by Rockwell Mfg. Co. in 20-pp Bulletin V-602. Covers fundamental method of determining pressure drops for lubricated plug valves, as well as method of estimating pressure drop through Venturi type valves.

222 Valve Selection Data — Facts to keep in mind when selecting a valve for a specific application are detailed in Crane Co.'s 20-pp Bulletin AD-2016. Three principal valve types are illustrated and described, and cutaway views showing component features.

223 Stock Solenoid Valves — Solenoid valves available "off the shelf" from Automatic Switch Co. are presented in 16-pp Stock List and Selection Guide 506. Contains engineering information, simple selection data, illustrations and flow diagrams.

224 Specifying Solenoid Valves — Included in Valcor Engineering Corp.'s 8-pp booklet on specifying solenoid valves are a description of various types of valve sealing; a discussion of mechanical specification criteria including application description, fluid characteristics.

225 To Control Water Hammer — This 56-pp standard catalog of Pulsation Controls Corp., details mutes, pulse traps, shock traps and blenders. Specifications, applications given.

226 Boiler Blow Off Valves—Bulletin E-125, 24 pp, describes and illustrates the design and construction of Everlasting Valve Co.'s quick-operating valves, angle valves, Y valves and duplex units specificaly designed for boiler blow-off service, dimensional data.

227 Blow-Off Valves—Described in Bulletin B435 by Yarnall-Waring Co. are hard-seat — seatless unit-tandem blow-off valves for medium pressure boiler applications. Advantages of the medium pressure unit tandem are detailed and specifications given.

228 Valve Operator—Catalog 14-C, Edward Valves, Inc., describes the Impactogear, a ring gear and pinion assembly permitting a man with portable air wrench or electric wrench to operate large cast steel globe valves without assistance.

229 Thermostatic Radiator Traps — Construction and operation features of thermostatic radiator traps and float and thermostatic traps manufactured by Sterling, Inc. are described in Bulletin 102. Includes diagrams, roughing-in dimensions and capacity tables.

230 Traps and Strainers—A handy working tool, 24-pp Catalog 400 of W. H. Nicholson and Co. provides streamlined data on thermostatic and expansion steam traps and strainers. Covers function, operation, typical applications. Features new trap sizing method and covers selection of traps for steam service, air and liquid heating, direct, indirect steam contact heating.

231 Guide to Strainers — Presented by Tate Engineering, Inc. in this 88-pp handbook are reference data for layout of fluid flow systems and sizing of strainers, tabulated results of testing, and valve and pipe selection information. Reference material for each strainer section is on a foldout page.

232 Self-Cleaning Strainers—Twelve-pp Catalog 6008, on strainers for steam, air, gas and liquids, details over 600 strainers and shows selection of materials, end connections, pressure ratings and sizes. Pressure-drop and pressure-temperature limit data are provided by Leslie Co.

233 Strainers — Twelve-pp Bulletin 170 of Armstrong Machine Works describes strainers of semi-steel, cast carbon steel, cast chrome, formed chrome, bronze and stainless steel. Connections are screwed, flanged, butt-weld, socket weld and Silbraz. Types of screens are illustrated and particle retention size detailed.

234 Steam Traps—This Condensed Catalog of Sarco Co., Inc. contains 12-pp of technical details, dimensions, and capacity data on steam traps, temperature regulators, and heating specialties. Cut-away views included.

235 Manual on Traps—This 40-pp engineering manual published by the V. D. Anderson Co. is designed to assist in the sizing, specifying and selection of steam traps and other fluid specialties. Includes steam trap selection guide, explanation of four basic types of traps and how they perform.

236 On Steam Traps—Catalog K is an enlarged 48-pp manual and steam trap catalog of Armstrong Machine Works. New material provided includes open float and thermostatic traps, pipe strainer to 6 in. steel and semi-steel, and helpful steam pipe sizing tables. Discusses fundamentals of trapping.

237 Good Piping Charted — Recommended piping practices are presented in this wall chart form by The Lunkenheimer Co. Chart is divided into five sections covering basic valve types, connections normally used, installation and maintenance tools, installation, operation and maintenance.

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238 **Pipe Dimension Chart** — For desk or wall mounting, this chart published by Midwest Piping Div., Crane Co., shows outer diameter and wall thickness for pipe from ½ through 42 in. Includes information on ASA Standard B36.10, showing IPS and schedule numbers and their relationship.

239 **Power Piping Erection**—Field erection of high-temperature, high-pressure power piping is the topic of this 12-pp bulletin released by The M. W. Kellogg Co. Illustrated with photos and diagrams, it shows how detailed plans are developed, field-erection costs and quality control.

240 **Pipe Ratings** — Technical Bulletin TBI-1960, 24 pp, offered by The Pipe Fabrication Institute, tabulates pressure-temperature ratings of carbon steel, molybdenum, chrome-molybdenum and chromium silicon molybdenum alloys in all standard sizes of seamless piping. Chemical requirements, in relation to the various types of seamless pipe and weight charts, are included. Available to qualified power engineers.

241 **Installing Pressure Pipe** — Form TR-62A is a 24-pp installation guide for Transite pressure pipe. Offered by Johns-Manville Corp., covers handling and installation of the pipe from loading and unloading to assembly of pipe and couplings, cutting and machining, service connections, backfilling, testing, repairing.

242 **Power Piping Equipment** — Pipe hangers, vibration eliminators and supports are presented in Catalog 58, 114-pp, by Blaw-Knox Co. with technical section devoted to charts, typical problems and specifications. Component parts and installation instructions given.

243 **Pipe Measurement Data**—Aeroquip Corp. tells how to measure and relate pipe, tubing and hose sizes in 16-pp Bulletin 631, covering standard methods of measurements, discussing both similarities and differences involved in measuring fittings and fluid-carrying lines to arrive at satisfactory fluid line installations. Standard practices of measuring adapters and complete assemblies are discussed

244 **Plastic Pipe, Fittings** — PVC pipe, valves and fittings and their uses are covered in this 36-pp handbook by Kraloy Plastic Pipe Co., Inc. Specification, design and installation data are included, as well as a comprehensive corrosion resistance comparison chart of seven types of plastic pipe carrying 162 chemicals.

245 **Pipe Thread Fittings** — Advantages of pipe thread fittings designed to eliminate positioning problems, leakage, and overtightening damage are detailed in this product bulletin of Tru-Seal Div., Flick-Reedy Corp. Common types of positioning distortion, alignment re-working and leakage problems covered.

246 **Improved Plastic Pipe** — Illustrated 10-pp Bulletin TR-2704A, issued by Johns-Manville Corp., contains tables of properties, working pressure, flow chart and other pertinent information for selection of Supreme plastic pipe. Includes tips on cutting.

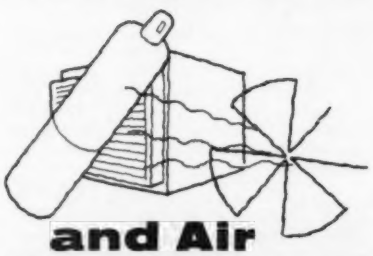
247 **Unions, Fittings** — In this 16-pp illustrated catalog, Stockham Valves & Fittings Co. gives complete details on design, weight and dimensions of unions and union fittings. Also included are engineering specifications and information on prices.

248 **For Moisture, Dirt Removal**—Bulletin 503 by The V. D. Anderson Co. describes Hi-eF purifiers (types LC, LCR) for moisture and dirt removal from air, gas and steam applications. Contains features, specifications.

249 **Supports for Piping** — Described in 96-pp Catalog 59, is a system utilizing pre-engineered standard components in almost infinite combinations to solve most piping and equipment support problems. The system, introduced by Bergen Pipesupport Corp., affords savings in engineering and field costs, offers simplicity of use.

250 **Pipe Alignment Guide** — This bulletin of The Align-O-Pipe Guide Co. introduces a device for guiding pipe lines whch are expanding or contracting because of temperature changes. Explains how units permit movement of pipe line in an axial directon only.

Ventilating, Refrigeration and Air Conditioning



251 **For Controlled Ventilation** — This 20-pp catalog of The Loren Cook Co. is designed as a guide in determining exact type ventilation equipment for specific needs. Guide matches design features with ventilation requirements and conditions.

252 **Heavy Duty Fans** — Operating features, construction details and engineering data on industrial airfoil centrifugal fans for heavy duty applications are presented by Westinghouse Electric Corp. in Catalog 1122.

253 **Centrifugal Fans** — Catalog 1120-1 of Westinghouse Electric Corp. contains 76 pp of detailed information on all-purpose centrifugal fans with flat, backwardly inclined blading, suited for supply and exhaust, general ventilation, industrial air conditionng and processes.

254 **Air Engineering** — Bulletin E-57, is a 24-pp air engineering data file, offered by Aerovent Fan Co., Inc. Covers engineering and test facilities for propeller fans, specifications, construction, maintenance, and installation. Tables for estimating air-handling requirements, losses provided.

255 **Conditioner Units** — Design features of Climate Makers, based on the building block principle, are detailed by Airfan Engineering Co. in 60-pp Catalog AHV-59. Gives fan capacities, and coil data, chilled water cooling capacities.

256 **Coil Selection Guide** — Information on Young Radiator Co.'s water and direct expansion refrigerant coils is given in 28-pp Catalog 5559. Provdes selection data on water heating and cooling coils; physical and performance charts; mean effective temperature difference charts.

257 **Air-Cooled Condensers** — Four types of air-cooled condenser units are discussed by Halstead & Mitchell in 12-pp Bulletin AC-102—those using propeller fans for horizontal air flow, propeller fans for vertical air flow, centrifugal fans for use with ductwork, and centrifugal fans.

258 **Refrigeration Condensers** — Engineering data on refrigeration condensers are featured by Henry Vogt Machine Co. in 38-pp Bulletin RC-2. Ratings in tons refrigeration are tabulated for large and small ammonia condensers, vertical ammonia condensers, Freon condensers

259 **Ventilation and Cooling**—Basic principles of ventilation and cooling and definition of American Coolair Corp.'s 'breeze conditioning" are presented in 8-pp Form 349. Typical applications in industry are detailed and figures on calculation of air volume required are given.

260 **Air Conditioning Units** — Detailed information on a packaged central station air conditioning unit designed by American Air Filter Co., Inc. to give exact type and degree of air cleaning is presented in 60-pp Bulletin AC-100. Component features shown, and selection data provided.

261 **Packaged Air Conditioners** — Performance characteristics and engineering features are given in color-illustrated Bulletin 8825, 12-pp, from American Standard Industrial Div. Installation photos show units with and without discharge plenum.

Postage-free Reader Service Cards are on pages 97-98

Boilers and Auxiliaries

262 Steam Generator—Bulletin F-14 contains 32 pp of detailed information on E. Keeler Co.'s water tube type steam generator. Photos and diagrams illustrate design and construction.

263 Integral-Furnace Unit — Bulletin G-94, The Babcock & Wilcox Co. describes Type PFI integral-furnace boiler, a pressurized-furnace oil- and gas-fired steam generator for power, process or heating loads requiring steam capacities to 400,000 lb-hr at up to 1150 psi and 900 F.

264 Packaged Boilers—A complete discussion of firetube boilers — from construction features to final test and start-up service—is presented in 12-pp Bulletin Form AD-178, Cleaver-Brooks Co. Color cutaway shows features of packaged boilers through 600 hp.

265 Automatic Boiler — Application of the Coal-Pak automatic package boiler to low-pressure steam heating, hot water heating, and high-pressure process steam is covered by Bituminous Coal Institute in 36-pp Guide specifications GS-3.

266 Packaged Steam Generator — Design and construction details, tables of capacities, dimensions, weights on a compact, portable shop-assembled water tube boiler with integrated firing equipment and controls are presented by Henry Vogt Machine Co. in 10-pp Bulletin PSG-3.

267 Hot Water Boilers — Twenty-pp Brochure HCC-2 of Combustion Engineering Co , Inc. describes and illustrates design, construction, advantages and economies of the C-E La Mont controlled circulation hot water boiler. The unit is for supplying high pressure, high temperature water.

268 Boiler Piping Hook-Ups—Facts about right and wrong piping hook up, testing, trouble shooting and replacements are covered in Bulletin M-88, a 20-pp pocket guide prepared by McDonnell & Miller, Inc. Gives examples of abnormal conditions and tells how to correct them.

269 Compact Steam Boiler — Type CC, an automatic, packaged steam boiler with capacities from 20 to 350 bhp, is described in Bulletin D2179 by Superior Combustion Industries, Inc. Includes typical boiler room layout.

270 Waste Heat Boilers—Applications of waste heat boilers and water heaters in waste heat recovery are described in 20-pp Catalog WHB 59-3 by Foster Wheeler Corp. Discusses two types of heating surfaces — extended surface tubes and bare surface tubes, and includes construction details.

271 Boiler Check List—This check list offer by Cleaver-Brooks Co. is designed to give tips on keeping a boiler clean and operating efficiently. Tells how to obtain better performance.

272 Heat Transfer Equipment — Design and construction features of heat transfer equipment are detailed in 20-pp Bulletin HE-8 of Henry Vogt Machine Co. Covers the positive seal baffle, film type heat exchangers, waste heat, boilers, high pressure and high temperature heat exchangers, exchangers of special alloys.

273 Heat Exchangers — Shell and tube heat exchnagers, including copper base alloy, steel and stainless steel fixed tube bundle heat exchangers, are described by The Young Radiator Co. in 16-pp Cataaog 1258A. Includes pressure ratings and material specifications.

274 Industrial Heat Exchanger — This selection data form of The Air Preheater Corp. covers industrial heat exchangers, including a package regenerative air preheater for industrial process or boilers in a range from 25,000 to 250,000 lb per hr; recuperative type heat exchangers for high temperatures, high pressure applications where leakage cannot be tolerated.

275 Short Retracting Blower—Bulletin 1079-C describes a short retracting lance type blower for water walls, tube banks, and hopper slopes. Available with manual drive, air motor or electric motor drive from Diamond Power Specialty Corp.

Tubing

276 For Condensers, Heat Exchangers — Publication B-2, 46-pp of The American Brass Co , discusses tubes and plates for condensers and heat exchangers, applications and problems encountered. Information on condenser tube alloys, plates for tube sheets and baffles, methods, installation covered.

277 Feedwater Heater Tube — Mechanical and physical properties of Cupro Nickel heat exchanger tube designed for use in power plant feedwater heaters are detailed in Bulletin DM-6104 by The Anaconda Co.

278 Factors in Tube Failures—Avaialble from Dow Industrial Service, Div., The Dow Chemical Co., is an 8-pp technical paper, "The Role of Copper and Physico-Chemical Factors in Steam Generator Tube Failures."

279 Tube Expanders—Features and advantages of Elliott Co.'s tube expanders for heat exchangers and condensers are detailed in 12-pp Bulletin Y-49. Includes tips on tube expanding, selection tables, data on tube expander controls, retubing accessories.

280 Boiler Tube Facts — Presented in this 28-pp pocket-size handbook of Boiler Tube Co. of America is information on the care and preservation of boiler tubes and the importance of intelligent attention to boiler tube problems. Useful tables, charts and memoranda provided.

281 Tube Cleaner — Featured in Sheet A-24 is a condenser and heat exchanger tube cleaner weighing only 10 lb by Airetool Mfg. Co. Operation advantages are detailed and specifications given.

Insulation

282 Thermal Insulation—Described in 54-pp Catalog IN-244A are Johns-Manville thermal insulations for all types of commercial and industrial requirements from—400 to 3000 F. Contains six sections, each devoted to a specialized group of insulations, including industrial and high temperature; plumbing, heating and air conditioning; refrigeration; insulating firebrick.

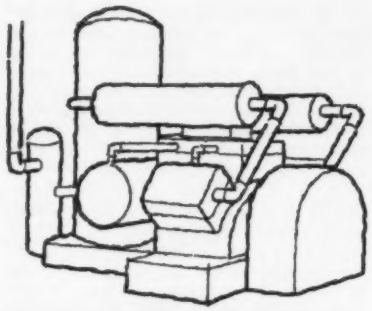
283 Thermal Insulation—This 16-pp bulletin released by National Insulation Manufacturers Association is designed to serve as a guide to best use of thermal insulating materials under changing conditions of modern industry. Emphasizes "economic thickness" approach to specification.

When using the Reader Service Cards, please be sure to give your company name and job title, even if you want catalogs sent to your home. Manufacturers prefer to send literature to those who identify themselves

284 Insulation Specifications — In this set of six specifications, Pittsburgh Corning Corp. covers applications of Foamglass insulation for industrial equipment and piping. Each booklet contains tables of suggested thicknesses of insulation to be applied, drawings of insulation procedure, supports and recommended finishes. Booklets are devoted to low-, medium-, high-, and dual-temperature equipment, to underground piping.

285 For Insulation Protection — Comprehensive data on mastics, coatings, adhesives, and flashing compounds for thermal insulation has been classified as to industry usage—power, process, cold storage, marine and commercial—in this ready-reference loose-leaf manual, about 208-pp, of Benjamin Foster Co. Detailed application data included.

Reader Service Post Cards make it easy to order catalogs



Pumps and Compressors

286 Power Plant Pumps — Bulletin BJP-588, Byron Jackson Pumps, Inc., describes standard pumps for all power plant requirements—from 12,000 hp double-case boiler feed pump, to condensate, circulating and booster pumping duty. Also describes special pumps for nuclear power plant installaiton.

287 Simplified Pump Selection—Technical data is simplified and presented in an easily-understood way in the Deming Co.'s rotary pump selection manual. Groups liquids according to viscosity and each classification has its own selection table. Fast selection is possible by matching liquid to pump.

288 End Suction Pumps—Described in Bulletin 158 are horizontal shaft, single stage, and suction pumps designed for handling abrasive mixtures and slurries, as well as corrosive and hot liquid. Various models on the line are described as to design and application by Nagle Pumps, Inc.

289 Rotary Air Pumps — Catalog 460, 32 pp, of Leiman Bros., Inc., describes rotary positive air pressure and high vacuum pumps, gas boosters and air motors. Gives construction details, dimensions, capacities, performance curves for all pumps, engineering data.

290 Centrifugal Pumps — Information on high pressure multi-stage centrifugal pumps of Goulds Pumps, Inc is contained in Bulletin 722.4, 8 pp. Models described have capacities to 2600 gpm for heads to 3400 ft. and working pressure to 1200 psi.

291 Adjustable Speed for Pumping —Rectiflow and MagnaFlow adjustable speed drives for pumping applications are discussed by Westinghouse Electric Corp. in 8-pp Bulletin 5560, an application data booklet. Provides a drive selector guide for water treatment stations, constant pressure pumping systems, industrial process.

292 Sizing Cooling Tower Pumps—Six steps to be taken in sizing pump and piping of any cooling tower installation are explained by Bell & Gossett Co. in 6-pp Bulletin CT-360. Provides seection charts, tables.

293 Pumping and Hydraulic Data —Definitions, formulae, testing, tables, charts and definitions useful in pumping any hydraulics are covered in 20-pp Bulletin EM-77 issued by Peerless Pump Div., Food Machinery and Chemical Corp. Includes facts on how to figure NPSH, pump efficiency, mechanical and electrical equivalents.

294 Vertical Turbine Pumps—Design, engineering and production facilities of Layne & Bowler Pump Co. and improvements and developments in their vertical turbine pump line are covered in 16-pp Bulletin 900.

295 Air Compressors—Heavy duty industrial compressors engineered for continuous duty are described by Joy Mfg. Co. in 36-pp Bulletin A-43. Performance advantages, basic construction features, general arrangement diagrams included.

296 Compressed Air Fundamentals — Sixteen-pp Form 1548, Ingersoll-Rand Co., is intended to aid in selection of a small "packaged" air compressor, Discusses compressed air, how it is compressed, single- and two-stage compressors, piston displacement, control used etc. Includes information on compressor oils, pipe sizes, wire sizes.

297 Compressor Valve Story—Operation and importance of valves in modern reciprocating compressors are described in 44-pp Booklet Form 3222 by Ingersoll-Rand Co. Questions and answer format details demands made on valves and their function in a compressor. Traces evolution of valving from 18th century types.

298 On Eliminating Explosions — In 12-pp Bulletin 173, Clark Bros. Co. presents recent findings on mechanism of explosions in pipelines and compressor starting air lines. Discusses research in nature of explosions and shock waves in piping, and these observations are applied to compressor air starting systems.

Packings, Gaskets

299 Packing Chart — This packing recommendation chart by Raybestos-Manhattan, Inc , shows basic packing types for 95 per cent of all packing needs. Covers such applications as: pumps and valves, high-temperature valve stem and expansion joints, high-speed rotary air compressors.

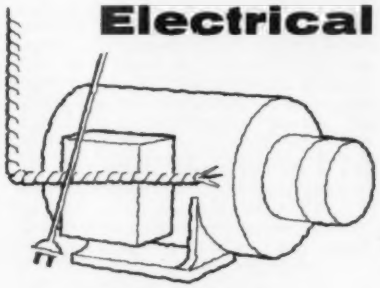
300 Mechanical Packing Guide — Johns-Manville's 64-pp catalog, Form PK-131A, contains comprehensive information on mechanical packings. Includes chemical selection chart listing more than 700 liquids common to process industries. Also featured is a simplified selection chart.

301 Mechanical Packings — Technical details on chemically-inert mechanical packings of Teflon are provided in Bulletin P-325, 8pp, by Crane Packing Co. Types, styles and sizes for industrial service conditions are listed. Operating temperature range from —120 to 500 F. Information on pressures, dimensions given.

302 O-Ring Handbook — Catalog 5711 is a 24-pp design and data book of Parker Seal Co. on Viton O-rings. Contains test information on some 150 fluids and gases to which this synthetic elastomer is compatible; recommended design techniques; general information on three compounds; data on all standard sizes.

303 Corrosion Resistance Chart — Over 150 chemicals and their recommended uses with ductile iron, iron, steel 316 and 304 stainless steel, Monel, brass, bronze, copper, aluminum and plastisol plastic are listed in Corrosion Resistance Chart J-CRC. Prepared by OPW-Jordan Corp., chart shows which gasket materials are needed.

Electrical



304 Induction Motor Selector — Selection, application and buying information on General Electric Co.'s Tri-Clad '55 motors, single- and three-phase, from ¾ to 150 hp is given in 14-pp Bulletin GEC-1049. Includes chart for various loads and ambient conditions, prices, performance data.

305 Synchronous Motors — Advantages of The Ideal Electric & Mfg. Co.'s high speed synchronous motors are detailed in 12-pp Bulletin 501 Cutaway view illustrates component parts and details of maintenance and operation.

306 Motor Application Guide — Sixteen-pp Bulletin 270B outlines characteristics of Century Electric Co. motors of 1/20 to 400 hp and includes up-to-date design information on them. Discusses factors in motor selection.

307 FHP Motors — Twelve-pp Bulletin GEA-6424A discusses features and advantages of General Electric Co.'s fractional horsepower, Form G, general purpose motors, including capacitor start, split-phase, permanent-split capacitor, shaded-pole and polyphase.

To use Post Cards, circle item numbers of catalogs wanted

308 Shielded AC Motors — Comprehensive 56-hp Catalog 200, Sterling Electric Motors, Inc., includes complete dimensional, selection and application data on Multi-Shielded a-c motors. Includes information for various modifications, such as specialized mountings.

309 Motor Selection Guide — This pocket-size card (GED-3909A) provides quick reference to frame size (182 to 445U) and book price for General Electric Co.'s a-c motors from ¾ to 125 hp. Data are tabulated for both drip-proof and totally enclosed fan-cooled Tri-Clad '55 squirrel cage, horizontal motors.

310 Pump Motors—This 34-pp brochure of U. S. Electrical Motors Inc. consists of a collection of technical articles on pump motors, illustrated with charts, diagrams, graphs, tables, and cutaways. Subjects range from turbine pump motor lubricants, pump motor bearings, to pumping stations.

311 Motor Selection Simplified — Twelve-pp Bulletin B-2515, illustrated in color, presents Duty Master a-c motors from 1 to 2000 hp, of Reliance Electric & Engineering Co. Product features of each motor are outlined.

312 Motor Application Guide—Sixteen-pp Bulletin 010, Century Electric Co., describes single-phase, three-phase and d-c motors, also gearmotors and selective speed drives. Selection charts match motor characteristics to specific applications. Characteristics covered.

313 On Electrical Machinery—Important theoretical and practical features of common types of d-c and a-c motors, generators and control equipment are presented by Fairbanks, Morse & Co. in 48-pp Bulletin E-100 P. Titled an "Electrical Machinery Catechism," it covers electrical terminology and phenomena.

314 Transformer Tips—General information, operating and maintenance tips and connections for pole type distribution transformers are presented by Allis-Chalmers Mfg. Co. in 52-pp Pocket Manual 61X9659. Includes helpful tables and engineering charts.

315 Unit Substations — Detailed information on features, operations and application of selectively-coordinated load center unit substations providing continuous power for a-c distribution systems is presented in 32-pp Bulletin GEA-3592L of General Electric Co. Compares types of load center arrangements and explains how selective coordination of load centers can be provided on any of four systems.

316 Distribution Centers—Bulletin GEA-7222, 24 pp, describes General Electric Co.'s integral distribution centers with liquid-filled transformers, 112½ kva and above (oil or Pyranol), and dry-type transformers, 300 kva and above. Provides data on incoming sections, transformer sections, and low-voltage equipment.

When ordering catalogs don't forget that the Reader Service Cards can also be used to request any literature offered in the ads

317 Unit Substations — Comprehensive Workbook PSG-6001, 24-pp, aids in planning articulated unit substations for secondary distribution, and features a suggested specification form detailing data for a properly coordinated substation system. Detailed specifications provided by Pennsylvania Transformer Div., McGraw-Edison Co., for incoming supply sections, transformer sections and outgoing feeder assemblies.

318 Distribution Transformers — Operating and maintenance benefits of Endur-All distribution transformers are detailed by Allis-Chalmers Mfg. Co. in 8-pp Bulletin 61B9943 Stresses advantages of higher overload capabilities.

319 Dry-Type Transformer — Comprehensive information on single phase, three phase and phase changer dry type transformers is presented in 36-pp Bulletin 102-261. Includes transformer photos, wiring diagrams, specifications and prices. Booklet is offered by Atlantic Transformer Co.

320 Electrical Distribution — Comprehensive information on electrical distribution products is presented in this 60-pp catalog of I-T-E Circuit Breaker Co. Sections cover molded case circuit breakers, individually-enclosed low-voltage power circuit breakers, and engineered products.

321 Electrical Distribution, Control—Complete with photos, tables of specifications, pricing information, wiring diagrams, this 155-pp reference catalog of Federal Pacific Electric Co. covers 30 types of products.. They include circuit breaker load centers, fusible service equipment, enclosed safety switches, low voltage fuses, molded case circuit breakers, enclosed breakers, etc. Book is available to qualified power engineers.

322 Industrial Power Systems — Principles of planning industrial power distribution systems for safety, reliability and economy while retaining flexibility and provisions for future expansion are outlined in General Electric Co.'s 48-pp Bulletn GEA-7139. Chapters cover choosing voltages, short circuit calculations, protective relaying, substation selection.

323 Wire and Cable Data — These composite, color-coded data sheets contain information formerly found only in many catalogs on wires, cables and power cords. Prepared by Continental Copper & Steel Industries, Inc., data sheets give prices, stranding, strand diameters, temperature ratings, weights.

324 Portable Cords, Cables — Specifications and characteristics of various portable cords and cables are presented in this 52-pp booklet of Kaiser Aluminum & Chemical Sales, Inc. Gives pertinent data on insulation and jacket compounds, and includes tables giving properties of 600-v portable cables, also 601-5000-v portable cables, and others.

325 Insulated Cable—Latest information on cables insulated with a butyl-base high voltage insulation for extreme resistance to ozone, heat and moisture is available in 48-pp Reference Manual 1131, The Okonite Co. Contains data on current carrying capacities, dimensions and design.

326 Cable Splicing Fundamentals —Illustrated with step-by-step photos, this 30-pp booklet of The Okonite Co. explains procedure for splicing and terminating rubber-Neoprene cables, shielded and unshielded. Also includes tape selector and estimating charts.

327 Rigid PVC Conduit — Applications of rigid polyvinyl chloride in the electrical field are detailed in this 20-pp buletin released by Kraloy Plastic Pipe Co., Inc. Included are comprehensive test results, specifications, installation tips, corrosion-resistance charts.

328 Why Plastic Conduit — Advantages of using plastic conduit in a variety of electrical applications are detailed in this 6-pp bulletin of Southwestern Plastic Pipe Co.

329 Transite Electrical Conduit — Described in 12-pp Bulletin TR-247A, by Johns-Manville Corp., are two types of Transite electrical conduit; a thin-walled, asbestos-cement conduit for installation in concrete and a thicker-walled conduit for direct burial. Table lists conduit requirements, properties.

330 Power Centers — Sixteen-pp Bulletin GET-3041, General Electric Co., gives application data on Cabinetrol power centers utilizing standard components. Gives specifications on squirrel cage, synchronous-motor, wound-rotor-motor and d-c motor combination starters, as well as incoming line breakers and secondary breakers.

331 Distribution Regulators — Information about overhead-type, single-phase distribution voltage regulators is presented by Line Material Industries, McGraw-Edison Co. in 20-pp Bulletin RV2. Includes application information, design and operating features, accessory data, and dimensions.

332 General Purpose Controls — Catalog 1260D, 72 pp, contains information on general purpose control devices available from General Electric Co. Charts are listed for motors from ¼ through 200 hp, affording quick selection of heaters and push button stations. Product descriptions are provided for both manual and magnetic motor starters, relays, solenoids, limit switches, others. Prices included.

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333 Reduced Voltage Controls—In 16-pp Publication 2100-PRD-202, Electric Machinery Mfg. Co. describes magnetic, low voltage, synchronous motor controls using auto-transformer or part winding starting. Shows dimensions and weights and details of construction. Controls covered are particularly suited where across-the-line starting is difficult.

334 Load Control Systems—Bulletin GET-2916B describes General Electric Co.'s load control systems for industrial plants which generate all or part of their electrical requirements. Describes tie-line and frequency control, reactive power control and power limiting control.

335 Low-Voltage Switching — Twenty-pp Electrician's Manual RM-610 offered by Remcon Div., Pyramid Instrument Corp., contains an introduction to low-voltage switching. Explains how company's remote-control switching works electrically.

336 Electric Motor Controls—Pocket Catalog 60, published by Furnas Electric Co., 56-pp, gives descriptions, ratings, prices for manual and magnetic starters, drum controller, pressure, foot and limit switches. Included are push buttons, related pilot devices, motor rating, heater coil data.

337 Safety Switch — A switch for protecting machines, equipment and processes against damage from stoppage or reduced speed is described and illustrated in Bulletin MS-3 offered by Fuller Co. Design, installation, operation, applications, photos and a cutaway drawing are included.

338 Reduced Voltage Starter — Eight-pp Bulletin GEA-6860, General Electric Co., defines reduced voltage starters, tells when and where to use them and how to select them. Contains starter selection table.

339 Electric Motor Controls—Contained in 72-pp Catalog 5900 of Furnas Electric Co. are selector charts for magnetic and manual starters, giving horsepower, motor speed, heater size, heater ampere ratings, enclosure choices. Covers manual starters, magnetic controls, drum controllers, pressure switches, others.

340 Interrupting Capacity Chart—This chart, prepared by Westinghouse Electric Corp., aids in selecting and ordering proper circuit breakers for each application. Interrupting ratings, available fault currents covered.

341 Maintaining Electrical Equipment — Maintenance and inspection practices to foretell and prevent failure for different types of electrical industrial equipment are described by Associated Research, Inc. in 52-pp Manual D-62. Contains comprehensive data on methods and instruments for voltage breakdown tests and measuring insulation leakage at high voltage.

342 Electrical Equipment Guide — Describing heavy duty electrical transmission and distribution equipment for commercial, industrial and other installations, this catalog digest of Continental Electric Equipment Co. contains detailed specifications. Presents interrupter, switches, medium voltage switchboards, unit substations, power centers, low voltage switchgear, panel type switchgear, bus ducts, bus plugs.

343 Basic Electrical Protection — Ten-pp Bulletin BPB issued by Bussman Mfg. Div. McGraw-Edison Co. gives information on motor protection, system selectivity to faults, fuse application and fuse selection. Tells how to coordinate opening time of protective devices so that a fault current will be isolated to the circuit of origin

344 Battery Technology — Bulletin GB-1896 is a 36-pp handbook of technical instructions and engineering data on the care of motive power storage batteries offered by Gould-National Batteries, Inc. It covers all phases of lead acid battery theory, operation and maintenance.

345 Power Supply Handbook — Specifications on regulated d-c supplies, frequency changers (variable frequency power sources) high-voltage power supplies (to 600 kv) and other high-voltage products, miniature transistorized power supplies inverters, and converters, and a-c line-voltage regulators are presented by Sorenson & Co., Inc. in this 32-pp book.

346 Silicon Rectifiers — Booklet B-7900, which tells why silicon rectifier packages offer d-c power saving to the electro-chemical and allied industries, is offered by Westinghouse Electric Corp. This 20-pp publication presents detailed description of a silicon power package and states advantages of silicon over other types.

347 Battery Chargers — Selenium or silicon rectifier battery chargers designed for station-type batteries used by utilities and industrial plants are described in this product bulletin of Syntron Co.

348 Overload Fault Currents—Sixteen-pp Section 7 of an aluminum conductor engineering data series offered by Aluminum Co. of America, discusses over-load and fault current limitations of bare aluminum conductors. Includes graphs showing maximum allowable time for various emergency or short circuit currents.

349 Electrical Testing Instruments — Twelve-pp Catalog 10-1.3 covers instruments for maintenance, installation and proof-testing of plant electrical equipment. Included are dielectric breakdown tests sets from heavy duty types with a-c or d-c potentials to 150 kv, through mobile, bench and hand-carried portable models. Booklet is offered by Associated Research, Inc.

350 Silicon Rectifiers—Detail information on features, operational characteristics and construction of General Electric Co.'s silicon d-c power supplies is presented in 6-pp Bulletin GEA-7066. Covers three basic types—general purpose, essential service, and synchronous-motor field-excitation units.

351 Grounding Facts—Latest NEC requirements for installation and operation of portable electric tools and equipment is given by The Arrow-Hart & Hegeman Electric Co. in 8-pp "Grounding Facts." Data on revised code requirements provided.

352 Industrial Capacitors—Twelve-pp Booklet B-7642, Westinghouse Electric Corp., answers questions concerning use of capacitors to reduce power costs, increase system capacity, and apply to industry. Subjects cover power factor, benefits of capacitors.

353 High-Voltage Testing — Bulletin 5-15.4 by Associated Research, Inc. tells how high voltage testing can be nondestructive. Covers causes of insulation breakdown, the minimizing of destructiveness by current limiting and other aspects of insulation testing.

354 Insulation Testers — Twelve-pp Bulletin 21-45, of James G. Biddle Co., describes models of Meg type Megger insulation testers. These are in the 500- and 1000-v class with sensitivities to 10,000 megohms in the 1000-v instruments. Discusses advantages of insulation resistance testing in electrical maintenance.

355 Portable Test Units — Presented in this 48-pp booklet of Multiamp Electronic Corp. is detailed information on portable test units for protective relays. Subjects treated include classification of relay tests; preparation for protective relay testing; reasons for an adequate testing and maintenance program.

356 Insulation Materials — Illustrated 36-pp Catalog 34 presents electrical insulation for repair and maintenance of motors, generators, and electrical or electronic equipment. Prepared by Insulation Manufacturers Corp., covers packaged insulation products: cotton, asbestos, and woven glass tapes; cotton, glass and varnished or saturated tubing, others.

357 Epoxy Insulation Selector — Systems selector for epoxy insulation (Bulletin E-100) by Hysol Corp. shows properties of selected electrical insulating compounds. Contains data on insulation selection, gives handling characteristics and physical and electrical properties.

358 Electrical Insulating Oils—Bulletin 58, 6-pp, gives technical information on Sun Oil Co.'s insulating oils for transformers and cables. Discusses functions of a transformer oil; gassing characteristics of oils, properties.

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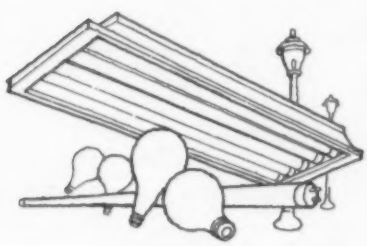
359 Electrical-Insulating Varnish —This 36-pp catalog of Minnesota Mining & Mfg. Co. covers selection and application of electrical insulating varnishes with complete details on all electrical and mechanical properties, operating temperature limitations.

360 For Hazardous Locations — Condulets for hazardous locations are illustrated and described by Crouse-Hinds Co. in 60-pp Bulletin 2722. Code articles 500-503, and 510-517 are quoted, along with recommendations for condulets meeting various requirements. More than 300 product photos, installation photos and drawings.

361 Channel Fittings, Hangers — This pocket-size reference type work manual, about 68-pp, contains product illustrations and correlated information for specifying and using structural support materials for electrical installations. A publication of Steel City Electric Co., it is indexed to areas of application.

362 Cable Troughs Solves Problems —This 28-pp catalog of The Globe Co. offers a solution to design problems of direction change or elevation with a set of standard fittings, horizontal elbows, inside and outside vertical elbows, ties, crosses, covers.



Lighting

363 Mercury Lamps—Technical information on initial and maintained lumen output, life ratings and essential electrical and physical characteristics of mercury lamps is presented in 28-pp Booklet A-7264 by Westinghouse Electric Corp. Also described are lamp construction, auxiliary equipment.

364 Fluorescent Lighting Guide — Theoretical and practical facts in fluorecent lighting, its advantages, are presented by Sylvania Electric Products Inc. in this 20-pp new edition of their popular reference guide. Sections on various types of lamps and accessories, lamp replacement included.

365 Floodlight Data in Brief — Pocket-sized Bulletin 2714 is a 184-pp miniature edition of Crouse-Hinds Co.'s floodlight catalog, and includes all original material. Covers selection of floodlights, general purpose floodlights, heavy duty models, mercury vapor floodlights, special types, lighting.

366 Lighting Specifications — Included in the 52-pp RLM Standard Specifications are three new specifications for 1500 ma units: D-4 fluorescent semi-direct medium high mounting, SD-3AL semi-direct aluminum, and SD-3PE semi-direct porcelain enamel units. The book contains many upward revisions of existing specifications, and new specifications for aluminum reflectors. Booklet is prepared by The RLM Standards Institute, Inc.

367 Floodlight Selection — How to select and apply floodlights is told by General Electric Co. in 16-pp Bulletin GEA-6175C. Describes floodlight classification, general principles of floodlighting, tells how to calculate light levels, includes recommended levels.

368 Area Floodlighting — Planning for lighting of parking areas and other open areas is detailed by Crouse-Hinds Co. in 16-pp Bulletin 2719. Contains reference guides for selecting incandescent or mercury floodlights, general purpose or heavy duty types.

369 Lighting Maintenance Tips — Principles and advantages of good lighting practice are presented in Champion Lamp Works' 48-pp lighting maintenance manual. Includes guide to trouble shooting, fluorescent installations, tips on planning group lamp replacement, cleaning.

370 Lighting Equipment — Illustrated and described in this 34-pp ring-bound lighting equipment catalog is The Wakefield Co.'s line of luminous ceilings, industrial fluorescent units, incandescent and mercury vapor units.

371 Modern Lighting Needs — "Footcandles in Modern Lighting," is General Electric Co.'s 20-pp revised booklet giving lighting level recommendations for seeing tasks involved in hundreds of industrial and other activities. Figures are based on findings of Illuminating Engineering Research Institute and Illuminating Engineering Society.

372 Incandescent Lighting — The 24-pp "Incandescent Lighting Guide Book" of Sylvania Electric Products Inc., features sections on the general advantages of incandescent lighting, the history of incandescent lamp developments, and includes chapter on basic types, bulb shapes, sizes, bases.

373 Group Relamping Plan—Eight-pp Booklet A-6832 describes a group relamping plan designed by Westinghouse Electric Corp. to reduce costs, provide better lighting, and cause fewer work interruptions.

374 Lighting for Industry — This 16-pp lighting guide (BLBS Form B-570) issued by Better Light Better Sight Bureau explains in non-technical language what's behind the higher lighting levels recommended.

375 Lighting Design — Twelve-pp Booklet VE-900 of Sylvania Electric Products, Inc. contains data on lighting terms, formulas and design factors in easy-reference form. Photometric tables simplify calculations.

376 Miniature Lamp Data — This 24-pp pocket size booklet of Chicago Miniature Lamp Works lists standard miniature lamps now available, and the sources of supply. Specifications of lamps (nearly 400) are given.

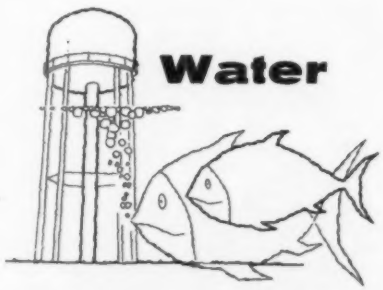
Coal

377 Where's the Coal — Peabody Coal Co. has issued a bulletin listing location of its coal reserves. A map shows location of coal reserves for most economical access to fuel supplies.

378 Coal Crusher Guide — Factors to consider in selecting a coal crusher for a particular operation are discussed by Gruendler Crusher & Pulverizer Co in Bulletin 154, 12 pp. Types of crushers and advantages of each are given. Capacity and specification data included.

379 Shredders, Crushers — Bulletin 257 of American Pulverizer Co. describes and illustrates hammer-mills and shredders, rolling ring and special crushers for reducing chemical, minerals, ceramics, and other materials including wood waste. Discusses construction features.

380 Industrial Materials Pulverizer —Advantages, capacities and dimensions for the type MB pulverizer for coal, limestone, gypsum and other materials are given in Bulletin MB-58-1 by Foster Wheeler Corp.



Water

381 Automatic Treatment Control — Methods for automatic control of water treatment plants are discussed in 8-pp Technical Reprint T-179 by Graver Water Conditioning Co. In two parts, Part 1 deals with control of demineralization plants and covers regeneration, quality control of effluent, conductivity, pH control. Part II considers control of cold process softening and clarification units, hot process-hot zeolite systems etc.

Reader Service Post Cards make it easy to order catalogs

382 **Water Requirements Calculator** — With this calculator (B-659P) you can quickly figure conversion of ppm water hardness to grains per gallon hardness, amount of exchange resin needed, brine and salt requirements, and brine tank size and operating brine level adjustments. Calculator, prepared by Morton Salt Co., can also be used in selecting tank size.

383 **Water Conditioning**—Automatic dispensers and water conditioning chemicals for preventive maintenance are described by Stiles-Karlsonite Corp. in this 24-pp bulletin. Discusses common water problems, preventive maintenance for cooling towers and evaporative condensers, and includes testing instructions, a "what to do" table for treating specific conditions.

384 **For Boiler Troubleshooters** — Bulletin CS 113 of Ionac Chemical Co. is a maintenance checklist covering boiler and cooling water system troubles and recommended treatments. Lists 23 common troubles arising from water and fuel contaminants and other causes. Gives diagnosis of causes for scaling, corrosion, foaming, etc.

385 **pH and Chlorine Control**—The 16th edition of W. A. Taylor Co.'s handbook "Modern pH and Chlorine Control," 100-pp, incorporating theory and practice of colorimetric analysis, serves as a reference for quantitative determination of pH, chlorine, phosphate, nitrate, sulfate, hardness and other tests. Methods are outlined for quantitative analyses. Available to qualified power engineers, please state job title.

386 **Boiler Water Treatment** — Chemical reduction of oxygen in boiler feed water with hydrazine is the subject of 10-pp Bulletin BW of Fairmount Chemical Co., Inc. Economy and operation, handling of the Deoxy-Sol, methods of analysis covered.

387 **Water Treatment Equipment**—Bulletin 4433, 12-pp, outlines modern water treatment equipment—aerators, degasifiers, deaerators, chemical feeders, precipitation equipment, filters and ion exchange equipment. Also tells how The Permutit Co. solves a water problem and nine ways to demineralize water (by ion exchange).

388 **On Zeolite Softeners** — "Care and Operation of Zeolite Softeners," covers bacterial fouling, deposits encountered and operational factors in relation to this equipment. Prepared by Betz Laboratories, Inc., it tells, too, how exchange materials should be handled to maintain maximum efficiency.

389 **Cooling Water Treatment** — Chemical treatment for industrial cooling water is described by Western Chemical Co. in this product bulletin. Discusses aspects of cooling water problems and how treatment can be effective in scale prevention, corrosion prevention and algae and slime control.

390 **Tray Deaerators** — Features and advantage of tray deareators designed to protect boiler tubes, internals, feedwater lines, auxiliaries and condensate return lines are detailed in this bulletin by The Permutit Co.

391 **Sodium Zeolite Softeners**—Described in 12-pp Bulletin 4520 by Cochrane Corp. is the sodium zeolite process of water softening. Includes information on selecting and sizing of equipment, automatic vs manual controls and capacity calculations.

392 **Treatment Instrumentation** — Provided in 30-pp Booklet D97-2 of Minneapolis-Honeywell Regulator Co. is a compilation of article reprints on instrumentation for treatment of water and sewage. What instruments are used, how used and their functions.

393 **Sewage Treatment Plant**—Outlined in this manual by Smith & Loveless is engineering data on small factory-built sewage treatment plants. Methods of treatment are covered and selection tables, design characteristics, and installation diagrams are included.

394 **Water, Sewage Treating**—Water, sewage and industrial waste treatment equipment of Link-Belt Co. is described in 20-pp Book 2617. Illustrates equipment and shows flow diagrams of installations in typical water, sewage, and waste treatment plants.

Metals

395 **Using Specialty Steels** — Offered by The Carpenter Steel Co., this 44-pp guide to selection of specialty steels contains information on tool and die steels; stainless steels; high temperature alloys; electronic, magnetic and electrical alloys; special purpose alloy steels; tubing and pipe, fine wire.

396 **Ferrous Metallurgy** — "Basic Guide to Ferrous Metallurgy" is a four-color chart prepared by Tempil Corp. showing principal characteristics of steels (with carbon content ranging to 0.9 per cent) across the temperature range to 1900 F. Important working zones including preheating for welding, stress relieving, normalizing, annealing, carburizing shown.

397 **Steel Analysis**—In this 20-pp pocket-size booklet, Jones & Laughlin Corp. lists compositions of 40 stainless steels, 184 alloy steels and 105 carbon steels most often used in industry. It also contains federal specifications with SAE, AISI and AMS numbers.

398 **Steel Weight Tables**—This 72-pp booklet, released by Jos. Dyson & Sons, Inc., contains weight tables of steel, including weights of round, hexagon, square, octagon, and flat steel bars in a wide range of thickness. Also includes decimal equivalents, tables of area and circumferences.

Materials & Maintenance

399 **For Masonry Anchoring**—Catalog 25 is a 48-pp pocket-sized handbook of anchoring and drilling devices produced by The Rawlplug Co., Inc. for fastening anything to masonry. Includes tables showing proper anchors for each type of fixture and material.

400 **Masonry Fasteners** — Fifty-pp pocket-size Catalog 160 of Diamond Expansion Bolt Co., Inc. lists anchors and fasteners for masonry and hollow walls. Covers machine screw anchors, lag screw expansion shields, machine bolt expansion shields, closed back machine bolt expansion shields, masonry drills, anchors.

401 **Handbook on Waterstops**—In the 24-pp Kwik-Seal Waterstop Technical Manual of The Gates Rubber Co. is a wealth of practical information on waterstops and their use. Covers size and shapes of the waterstop, comparative data for rubber and plastic types, handling and storage.

402 **Concrete Admixtures** — This 32-pp bulletin is issued by The Master Builders Co. as a guide to concrete admixtures, iron-armoured floor products, grouting and waterproofing materials and other related products for improving concrete and mortar. Contains comprehensive specifications for concrete floors, equipment grouting and masonry mortar.

403 **Roofing Guide** — General requirements for built-up roofing are covered in this 28-pp 1961 manual by The Philip Carey Mfg. Co. Steep deck and dead level roofs, spray pond roofs, promenade tile roofs, roofing over existing roofs, insulation are covered.

404 **100 Power Tools**—Information on electric power tools and accessories for construction, maintenance and other applications is presented by Skil Corp. in this 68-pp 1961 catalog. Specifications and selection tables are included for worm-drive power saws, metal-cutting power hacksaws, all-purpose reciprocating saws, jig saws, drills.

405 **Tool Buyers' Guide** — Catalog 60, complete with specifications and prices, is a 68-pp ordering book on Double Circle tools of Chicago Latrobe. Covers drills, reamers, end mills, countersinks, carbides, counterbores, others. Also provides information on features and applications.

406 **Tips on Grinding Wheels** — Over 1600 abrasive wheel recommendations for grinding everything from agate to zirconium are set up in alphabetical order by The Carborundum Co., in this specification catalog, about 57-pp. Material, work, operation — with their respective recommendations on abrasive, grit, grade—are listed.

To use Post Cards, circle item numbers of catalogs wanted

407 **Grinding Wheel Chart** — Information contained in this chart is based on rules and regulations established by the American Standard Safety Code for use, care and protection of abrasive wheels. Prepared by the Grinding Wheel Institute, it lists "do's and don'ts" of wheel care.

408 **Pipe Fitters Manual** — Information expected to be at the finger tips of pipe fitters and pipe welders is concentrated into this 72-pp fitters manual offered by Tube Turns Div., Chemetron Corp. Text, tables and illustrations in the pocket-size handbook give important mathematical, physical, chemical and metallurgical data.

409 **How to Bend Conduit** — This 12-pp pocket-size booklet of Appleton Electric Co. gives instructions for making precision bends in electrical metallic tubing, rigid steel, and rigid aluminum conduit. Covers five fundamental bends — angle bends, stub lengths, back-to-back bends, offset and three-bend saddles. Diagrams show techniques for on-the-spot bending.

410 **Conduit Bending** — Illustrated Bulletin 260, on bending conduit or pipe easily and accurately, features an improved bender. Prepared by Lidseen of North Carolina, booklet covers calculating lengths of legs, locating bend, back-to-back method, back-to-back push-through.

411 **Vest Pocket Welding Guide** — This revised edition of "How to Get Better Welds," published by Hobart Brothers Co., contains 80 pp of arc welding information. Covers essentials for proper welding procedures, good and bad welds, welding positions, operator qualifications, welding metals and steel available for welding. Also deals with causes and cures of trouble.

412 **Tips on Welding** — This 56-pp welding, brazing and soldering alloy and flux catalog and instruction manual issued by All-State Welding Alloys Co., Inc. covers physical properties, major uses, detailed application instructions and latest techniques for welding, brazing, soldering, cutting and hardfacing.

413 **On Welding Electrodes** — Contained in this 64-pp electrode pocket guide of Air Reduction Co., Inc. is information on all types of electrodes including mild steel, low alloy, low hydrogen, iron powder, stainless steel, hardfacing, non-ferrous and cast iron. Covers applications, procedures and pertinent data on each electrode.

414 **Welding Data** — This 148-pp pocket-size maintenance welding data book, issued by Eutectic Welding Alloys Corp., provides a guide, indexed by application, to nearly 200 rods, electrodes, and chemical aids. It illustrates and explains general welding techniques and joint design hints, and covers elimination of warping, distortion, embrittlement.

415 **Welding Pressure Lines**—Twenty-pp Bulletin 2112.2 of Lincoln Electric Co. contains practical tips on techniques and costs related to cross country transmission and pressure piping systems. Hand welding techniques are described. Also covered are API pipe specifications, analysis and properties. Includes chart on pounds of electrode consumed per joint for various size pipe.

416 **Arc Welding** — Basic information concerning arc welding techniques for small diameter piping is contained in Lincoln Electric Co.'s Bulletin 2112.3. Lists advantages of welded piping installations; describes procedures, explaining calculation of welding costs.

417 **Hardfacing Electrodes, Wires** —Cross-referenced pictorial data on hardfacing materials classified according to use is presented by Air Reduction Co., Inc. in 44-pp Form ADC 955. Lists equipment parts that benefit from hardfacing, type of wear and alloy needed to protect it.

418 **Brazing Techniques** — This 24-pp manual contains data for brazing shapes, sheet, castings, tubing and assemblies of aluminum, cast iron, copper, brass and steel. Covers such basic functions as heat, flame and torch settings, allows selection and joint design. Solutions to common brazing problems are answered by All-State Welding Alloys Co., Inc.

419 **Guide to Preheat**—Welding of low-alloy, high-tensile steel and other alloy steels with the aid of preheat is expained by J. B. Nottingham & Co., Inc., in 40-pp "A Guide To Preheat." Physical and chemical changes that take place in these problem steels during and after welding outlined.

420 **Power Plant Cleaning** — This fact file of Chas. Pfizer & Co., Inc. includes Data Sheet 557 on chemical cleaning with citric acid solutions, organic acids for cleaning power plant equipment, operation and water conditioning of a power plant, and Technical Bulletin 102 on cleaning products.

421 **Protection Against Rust**—This 38-pp treatise (Form 259) on rust and corrosion control by protective coatings shows actual color standards of Rust-Oleum Corp.'s primers and top coatings. Covering water resistant, heat resistant floor coatings, galvanized metal coatings, quick-dry coatings. Bulletin contains full-color application photos and 110 color chips.

422 **Painting Galvanized Steel** — Effective techniques for painting galvanized steel sheets are explained in this 16-pp booklet, produced jointly by the American Iron and Steel Institute, the American Zinc Institute, and the National Paint, Varnish and Lacquer Ass'n. Discusses main reasons for this painting: appearance, heat reflection.

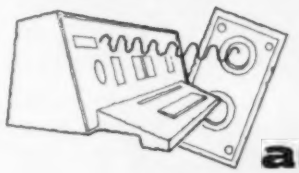
423 **Aluminum Paints in Color**—Protective and decorative advantages of painting with aluminum in color are discussed by Aluminum Co. of America in Form 30-11451. Illustrated in full color, shows examples of use of this metal-bright paint on structures.

Lubrication

424 **Lubricant Data** — Characteristics, advantages of specialized fluid and grease type lubricants are described in 32-pp data Book 59-2, by Lubriplate Div., Fiske Bros. Refining Co. Includes sections on control of friction, use of grease type lubricants, proper applications, and recommendations for various conditions.

425 **Organized Lubrication** — Benefits of organized lubrication are extolled by Texaco, Inc. in this 24-pp bulletin. Cost control opportunities are detailed, and task of assigning responsibilities in an organized lubrication system are discussed.

Automation, Instruments



and Controls

426 **Automatic Controls** — Comprehensive data on mercury-switch equipped controls for single-stage pressure, two-stage pressure, differential pressure single-stage temperature, two-stage temperature, liquid level and mechanical movement are presented by The Mercoid Corp. in 56-pp Catalog 860. Specifications provided.

427 **Telemetering Systems** — Metameter telemeters for remote measurement, recording and automatic control are described in 52-pp Bulletin M1715 of The Bristol Co. Covers principles of operation, types; application to various factors including pressure, water level, temperature, flow, motion.

428 **Industrial Controls** — This 88-pp catalog presents comprehensive information on controls, offered by General Controls Co., including automatic temperature, pressure, level and flow controls, as well as counters, switches and automation controls. Other items described are industrial actuators, combustion instrument controls, indicators.

To order catalogs, use the Reader Service Post Cards

429 Custom Control Systems—Coordinated control systems for process control, power plant control, machine control and motor control are illustrated and described by Electro-Mech Corp. in 8-pp Bulletin 203.

430 Pneumatic Control Stations — Features and advantages of pneumatic control stations designed for operating and maintenance simplicity are detailed in 8-pp Bulletin 1031 by Copes-Vulcan Div., Blaw-Knox Co. Describes standard auto-manual stations, as well as remote-set and cascade auto-manual stations, pneumatic loading stations.

431 Temperature Regulators—Air-control temperature regulators designed to cascade an air signal from a temperature pilot onto a pressure regulator which, in turn, modulates steam flow to meet heat exchanger demand, are described in Form S.E.M. 9 by Spence Engineering Co., Inc.

432 Temperature Controls — Filled with charts, drawings and diagrams, 24-pp Bulletin 101, of the Partlow Corp., discusses industrial temperature measurement and control, including ways of responding to temperature, ways of putting temperature response to work, mercury-bulb instrumentation.

433 Instruments and Controls—Illustrated and described in Bulletin G-14-1, by Bailey Meter Co., are fluid meters for recording, indicating and integrating; transmitters and recorders for pressure and draft; level transmitters; and temperature instruments, as well as plug-in components, analysis instruments, and analog and digital systems.

434 Instruments and Controls — Catalog 57-6, Republic Flow Meters Co., describes instruments and controls, including flow meters, liquid level or pressure gage, CO_2 meters, boiler meters, pneumatic transmitters, strip chart recorder, pressure, vacuum and differential recorder, others.

435 Definite Purpose Controls — Eight-pp Bulletin GEA-7316 describes General Electric Co.'s definite purpose contactors and starters for air conditioning and refrigeration. Outline drawings and dimensions are included along with load data ratings.

436 Temperature Controls — Brief descriptions and specifiations for 17 temperature controls are given by Fenwal Inc. in 8-pp Catalog MC-203. Covers Thermoswitch units, miniaturized local controls, fire and overheat detection models, snap action controls.

437 Industrial Thermometers — Illustrated and described in 68-pp Catalog 100B by Manning, Maxwell & Moore, Inc., are mercury, vapor pressure and gas actuated dial thermometers, red mercury tubing industrial glass thermometers, and recording thermometers. Dimensional drawings and specifications are included.

438 Guide to Gages — Catalog 300-B, 112-pp, features Ashcroft, Duragauges, Maxisafe, pneumatic receiver, recording, drawn case, chemical and special application gages of Manning Maxwell & Moore, Inc. Also presented are gage testers, pneumatic transmitters, gages for nuclear energy. Engineering data and charts are provided.

439 Pressure Gages — Featured by J. E. Lonergan Co. in 46-pp Catalog 1000G are pressure indicating and vacuum gages for industrial, chemical, and refinery applications. Selector tables give data on various gages and recommended services. Specifications, dimension diagrams included.

440 Draft Gages, Instruments — Bulletin 354-B is a condensed catalog of Ellison Draft Gage Co., Inc., covering stationary and portable draft gages, pitot tubes, air filter gages, gas analyzer, steam calorimeters.

441 Hydrostatic Instruments — In this 88-page pocket-size handbook of hydrostatic instrumentation, Petrometer Corp. includes information on principles of hydrostatic measurement, selection and installation of instruments, design and construction of panel systems, as well as engineering data and diagrams. Provides tank volume formulae, conversion tables.

442 Test Instruments—Catalog G-10 contains 48 pp of data on recording, measurement, and testing instruments of Minneapolis - Honeywell Regulator Co. Covered are d-c amplifiers, data handling systems, calibration instruments, magnetic tape instrumentation, nuclear instrumentation, oscillographs, recorders and indicators, others.

443 Catalog of pH Electrodes — Twelve-pp Bulletin 86-N, Beckman Instruments, Inc. describes pH meters and buffers and includes selection data on electrodes available for varying conditions of temperature, pH range, sample size, sample consistency, etc. Covers glass electrodes, reference electrodes, combination electrodes.

444 For Feedwater Analysis—Bulletin 148BP, Cambridge Instrument Co., Inc., contains a technical discussion of manufacturer's analyzers for determination of dissolved oxygen and hydrogen in feedwater. Discusses both O and H units as to function, ranges.

445 How to Select Recorders—Buying information on recording instruments of General Electric Co. is provided in 12-pp Bulletin GEA-6933, including dimensions and chart speeds, operating specifications, applications, features and accessories.

446 Steam Temperature Control — Operation and control of high steam temperatures is described in Bailey Meter Co.'s Bulletin 543. Three detailed diagrams explain principle of desuperheater water control and burner tilt and desuperheater water control.

447 On Thermocouples — Detailed information on thermocouples and thermocouple components and accessories is contained in 50-pp Catalog EN-S2 of Leeds & Northrup Co. Lists and describes standard assemblies in protecting tubes and wells for general applications; specialized thermocouples and assemblies; and bare and insulated thermocouple wires.

448 Automatic Controls — Selection and application information on automatic controls for steam and water service is presented by The Powers Regulator Co. in 46-pp Engineer's Manual. Covers controls for fuel oil heaters, heat exchangers for cooling, instantaneous heat exchangers, jacket water cooling, process hot water, pressure reduction, storage heaters.

449 Timers and Counters — Condensed Catalog D-31 contains 30 pp of reference data on automation components and control systems, covering latest timing components and linear measuring systems. Standard timers and counters are reviewed as well as electronic timers, package control systems, test equipment, switches, controllers, other products of Automatic Timing & Controls, Inc.

450 Data Processing at Work — Data processing equipment of Leeds & Northrup Co. now in use throughout the country is described in 48-pp Preliminary Technical Publication N-07 (1). Installations covered include digital data processing and analog and digital computing systems. Explains type of inputs, input switching.

451 Automation for Utilities—Automated equipment and systems for electric utilities are described in General Electric Co.'s Bulletin GEA-7044, 244 pp. All phases of system operation —generation, transmission and distribution are covered, as well as automatic load dispatching covering the areas of load-frequency control.

452 Computer Technology — Latest advances in computer technology and equipment are presented by Computer Systems, Inc. in "New Solutions in the Science of Simulation," 20 pp. Features the Dystac (Dynamic Storage Analog Computer), a hybrid computer combining analog computer's speed, lower cost, ease of programming.

453 Computer Talk — This 22-pp glossary of "computerese"—the language of electrical brains — is compiled by Minneapolis-Honeywell Regulator Co. to make computer language more intelligible to the layman. Defines over 82 terms found in the vocabulary of computer engineers.

454 Before the Computer Comes—Prepared by the Philco Corp., this 8-pp booklet tells what to do before installing an electronic data processing system. In non-technical language, booklet describes system analysis, specifications, design and operation.

Postage-free Reader Service Cards are on pages 97-98

455 Automatic Programming Systems — Details on automatic programming systems by Bendix Computer Div., The Bendix Corp. are presented in 8-pp Bulletin AR-1060. Characteristics of various systems designed to solve a variety of programming problems are covered.

456 Compiler-Translator — Act I, an electronic algebraic compiler and translator, is described in 18-pp Manual S-520 of Royal McBee Corp. Explains "source" program language—a series of algebraic and logical statements. Stresses simplicity of use.

457 Teaching Servo Systems — A new method of teaching servo systems that bridges the gap between theory and practice is described in 8-pp Special Report SR-3 by Servo Corp. of America. Explains how packaged assembly of electronic and electrochemical components permits students to build and test servo systems.

458 Selsyn Systems — Bulletin GEA-7218, 6 pp, details indicating and remote control applications of selsyn monitoring systems of General Electric Co. Lists indicator arrangements available. Explains use of cam-operated limit switch as an automatic feedback control.

459 Combustion Control Systems—Detailed information on combustion control systems for gas-fired boilers is presented in 16-pp Bulletin MSA-116A by Hagan Chemicals & Controls, Inc. Types of systems and safety devices are described.

460 Combustion Controls—Eight-pp Bulletin 3-001, issued by The North American Mfg. Co., describes combustion controls for furnaces, ovens and boilers. Gas pressure and furnace pressure control, ratio control discussed.

461 Electronic Combustion Controls — Twenty-pp Bulletin 1002, of Reliance Instrument Div., Electro-Mech Corp., describes electronic combustion controls, including oxygen analyzers, flow meters, draft gages, control valving, interlock switches and flame safeguard equipment.

462 Nuclear Instrumentation — Detailed information on nuclear instrumentation and accessories is presented in 50-pp Condensed Catalog F of Tracerlab Inc. Covers all phases of nuclear study and includes detectors, counting and radiation analysis equipment, sample changing equipment and adjuncts for personnel protection.

463 Radioactivity Measurement Instruments — Illustrated and described in 96-pp Catalog S by Nuclear-Chicago Corp. are more than 250 instruments for radioactivity measurement, many of them recently developed products. Included are counting systems, ratemeters, portable survey meters, detectors, neutron generators, training instruments, radionuclides, shielding.

464 Electronic Governor — Bulletin GEA-7231, General Electric Co., describes a speed and load-sensing governor offering accuracy, high response. Discusses operation and includes block diagram of the system.

465 Automation System — Bulletin G-2500, 16 pp, issued by Reliance Electric and Engineering Co., explains how drive speeds of machines and processes can be automatically controlled and regulated by simple pneumatic instrumentation. Applications illustrated.

466 Solid State Annunciators — Purpose of annunciators in monitoring process variables and use of solid state components in annunciator systems are detailed in 12-pp Publication 3060 by Thomas A. Edison Industries. Illustrates components of a system, tells how annunciators work.

467 Miniaturized Electric Eyes — Bulletin 611, 22 pp, covering all phases of electric eyes in automation, is both "answer book" on problems and reference manual on photoelectric controls. Prepared by Photomation, Inc., shows diversified photoelectric systems, includes data on miniaturized light sources, photo units, electronic controls.

Safety

468 Special Fire Protection — Devoted to special hazard fire protection, this 44-pp booklet of Grinnell Co., Inc. covers both equipment and methods. Tells how to recognize special fire-hazardous conditions in a plant. Discusses major types of fire protection, telling how each functions, giving advantages.

469 Fire Control Tips — This fire control chart, AD3003R8, shows fire extinguishers and gives detailed information including ratings. Prepared by Walter Kidde & Co., Inc., gives data on Class A, B and C fires.

470 Color for Safety — Offered by Valdura Heavy-Duty Paint Division, American-Marietta Co., this 6-pp booklet shows a cutaway section of a typical industrial plant with all danger areas painted in appropriate safety colors. Lists recommended colors for every safety application.

471 Markers, Signs—Illustrated in full color, this 24-pp catalog of North Shore Nameplate Div., Anodyne, Inc., provides information on pipe and electrical markers, numerals, letters, safety and identification signs all available from stock. Explains how markers are applied, also includes prices.

472 Handling Flammable Liquids—Problems involved in use of flammables and methods and equipment required for safe control are described by The Protectoseal Co. in this 76-pp safety handbook. Physical properties and characteristics of most commonly used flammables are detailed.

Other Equipment

473 Pneumatic Products — Catalog 1000, 64 pp, covers pneumatic products available from C. A. Norgren Co. Describes compressed-air-line filters, pressure regulators, air-line lubricators, valves, others. Also provides practical engineering information, such as compressed-air flow chart, moisture content of saturated, compressed air.

474 Torque Manual — This 32-pp catalog is a recent revision of P. A. Sturtevant Co.'s popular torque manual. Includes application illustrations, bolt charts, discussions on assembly characteristics, instructions for torque wrench testing, pictures of modified and special torque wrenches, formulas.

475 Corrosion Data Charts — Corrosive effects of almost 400 different materials on 16 types of metals are shown in corrosion data charts contained in Technical Service Bulletin 101 issued by Nooter Corp. Charts indicate corrosion resistance of metals to various chemicals.

476 Cathodic Protection — Booklet describes corrosion control for buried or submerged piping, tanks, ships and similar structures. The company's consulting services, field surveys, design, installation and materials as well as general cathodic protection procedures are discussed in detail by Harco Corp.

477 How to Use Wire Rope—Comprehensive information on use and abuse of wire rope is presented in this pocket-size 92-pp manual offered by Macwhyte Wire Rope Co. Covers selection of wire rope, constructions, capacities, maintenance and lubrication, breaking-in of wire rope, approved methods of seizing wire rope.

478 Engineering Know-How — "Background and Experience," a 24-pp handbook, touches upon services of Stone & Webster Corp. in design and construction of complex projects and in consulting work. Discusses activities in electric power and transmission systems, nuclear power, dams and hydro plants, industrial plants, gas work, defense projects etc., foreign work.

479 Oil-Burning Equipment Guide —Instructions for the care and operation of oil-burning equipment is discussed by The Engineer Co. in Bulletin OBI-38, 44 pp. General requirements for efficient operation, emergencies, safety precautions, fuel oil equipment and installation, installation and operation of fuel oil pumping and heating systems and its properties are covered.

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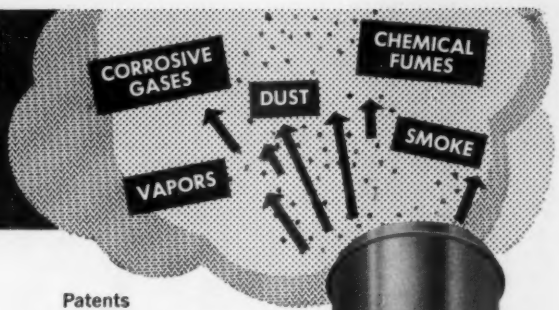

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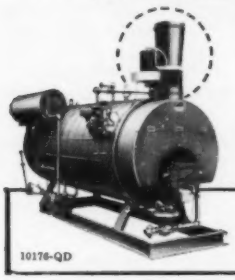

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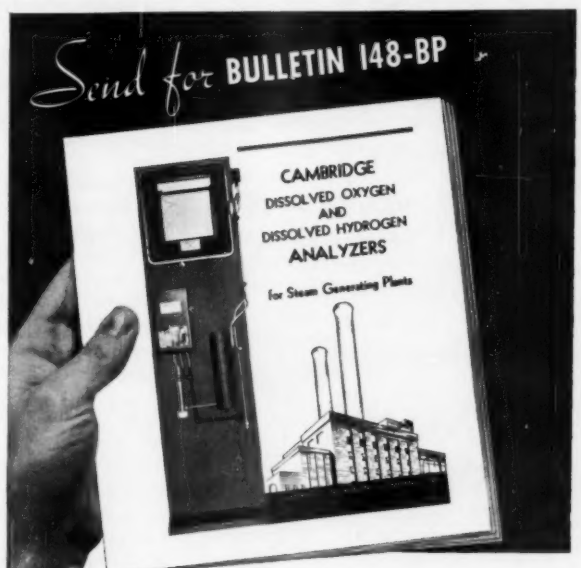

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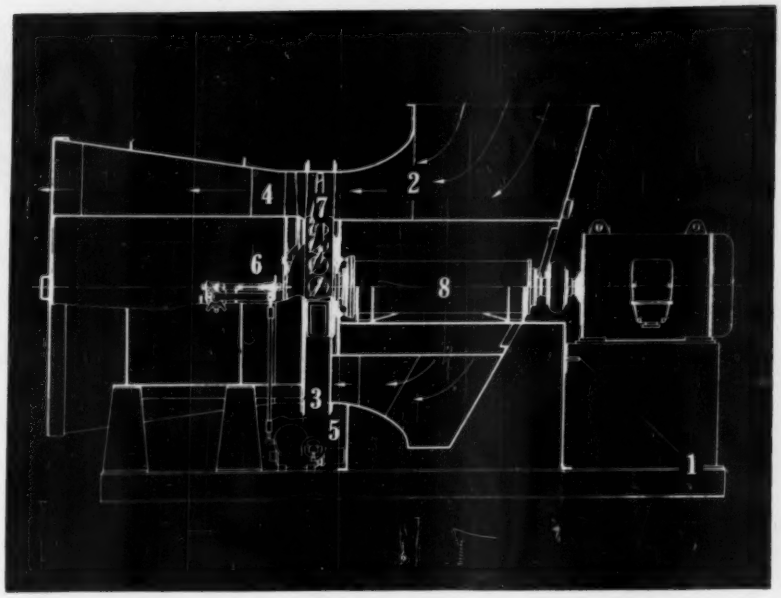

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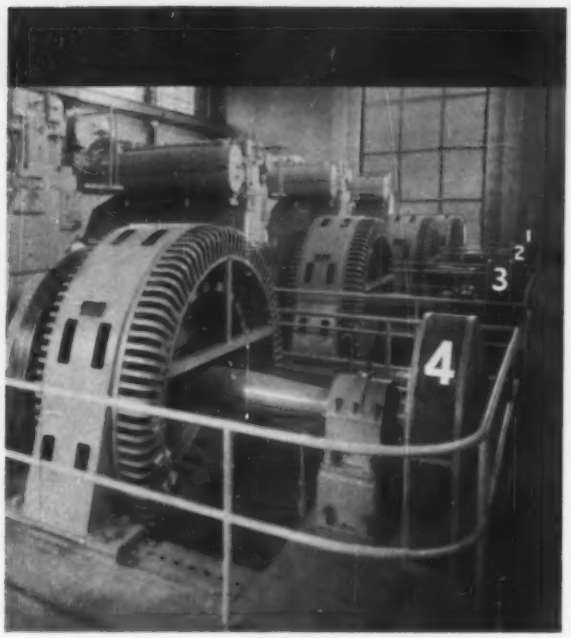

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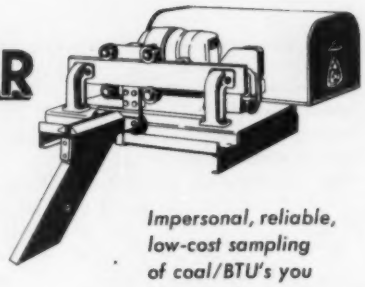

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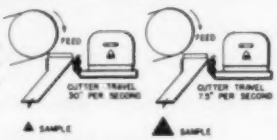

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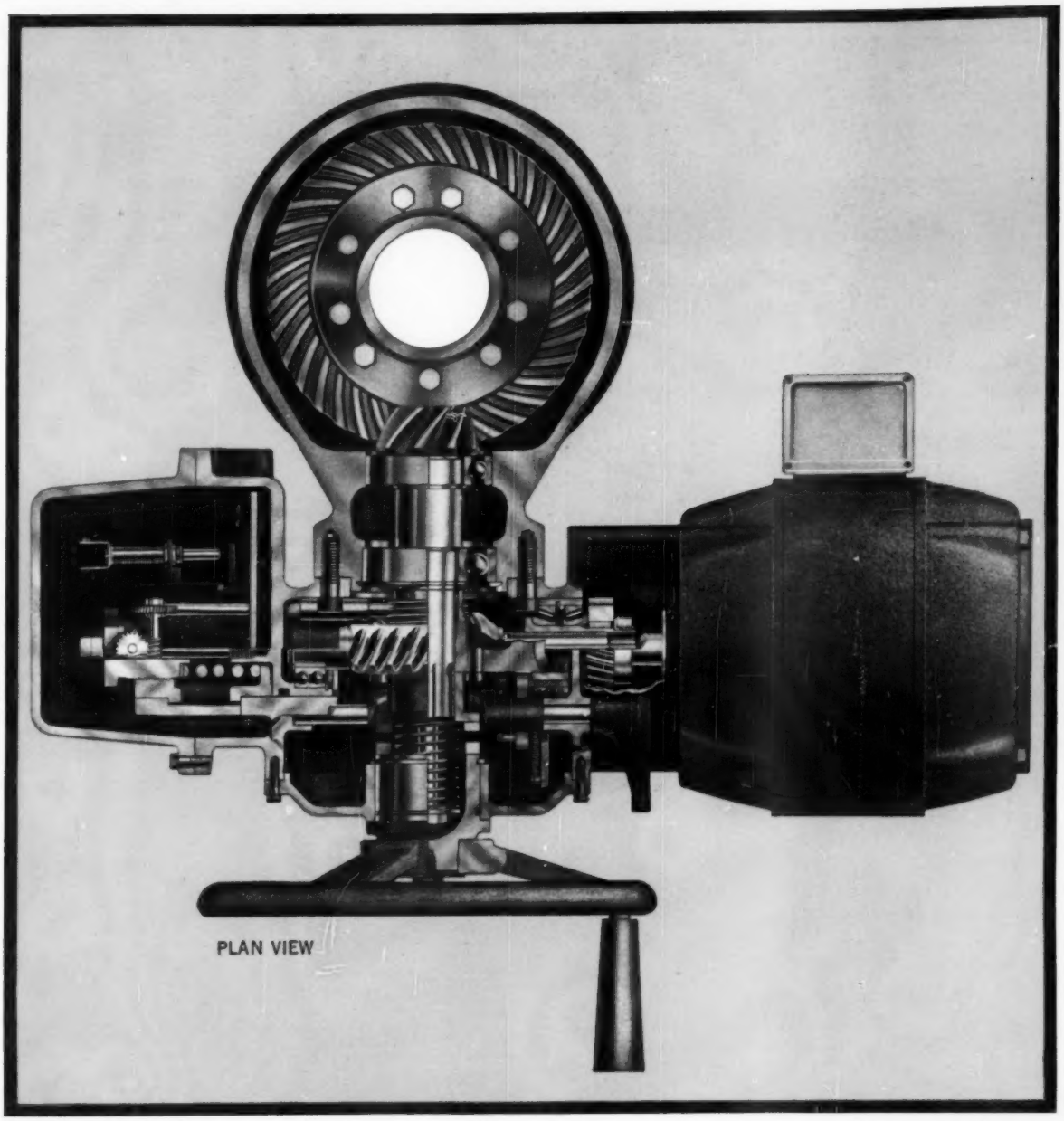

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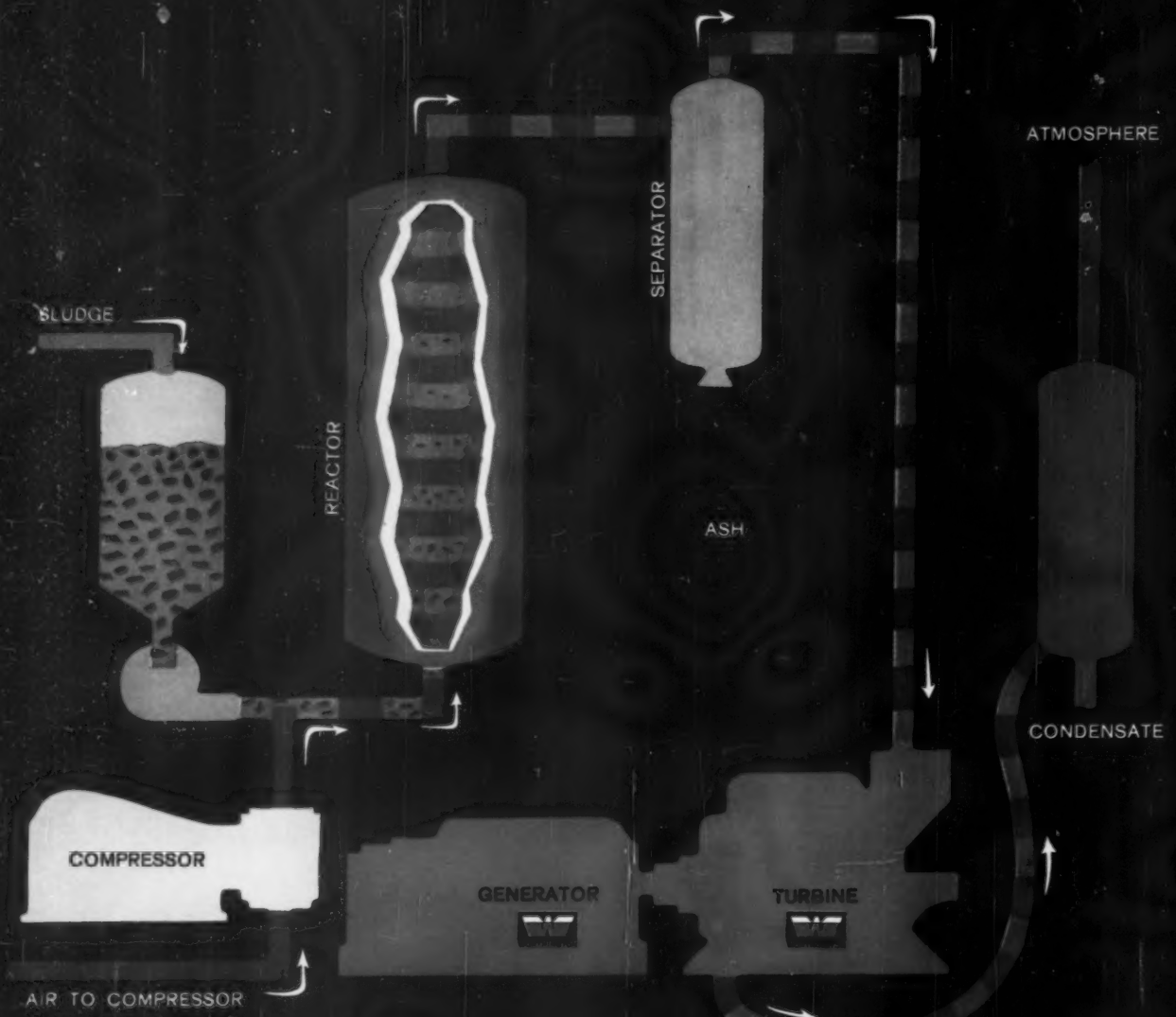

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